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147: Journal Section of the American Society of Heating and Ventilating Engineers

Heating and air conditioning systems and the controls to maintain desired conditions must be designed as integral units

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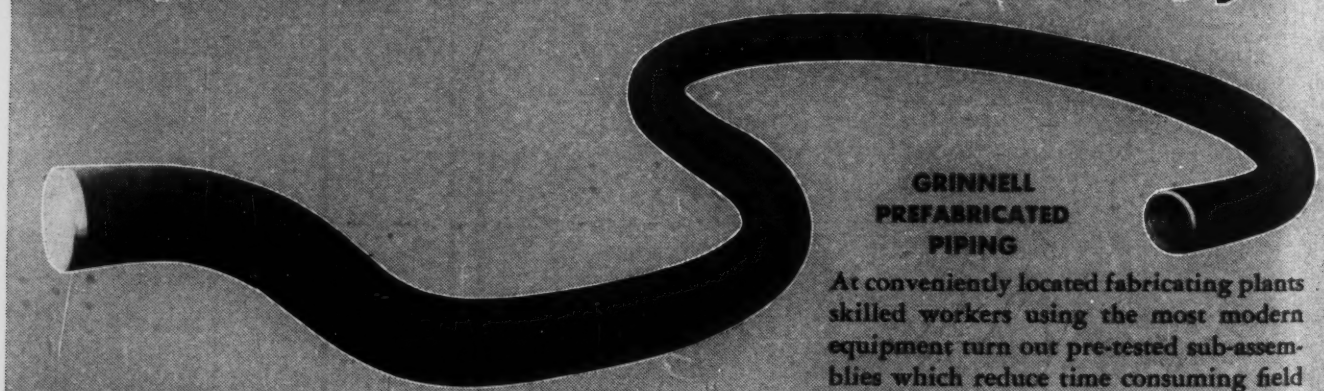

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Published monthly by the Keeney Publishing Co., 6 North Michigan Avenue, Chicago 2, Illinois. Telephone: State 6916. Subscriptions: U. S. and possessions, Canada, Mexico, Central America, South America, $2.00 per year; other, $4.00. Current copies, U. S. and possessions, 25c each, back copies, 50c each. January 1944 issue, $1.00 per copy. Member of the Audit Bureau of Circulations and of the Associated Business Papers, Inc.

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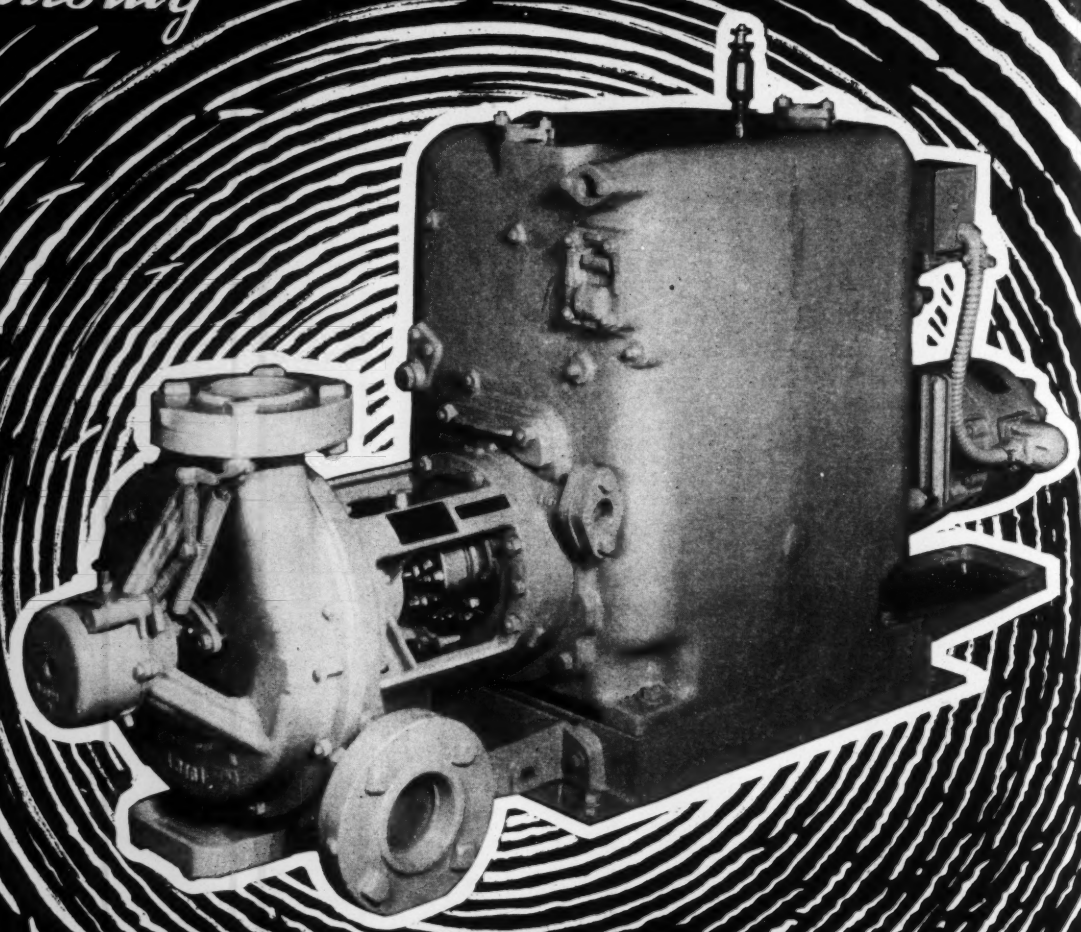

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BASIC PRINCIPLES

Design and Control of Year 'Round Comfort Air Conditioning Systems

By William Goodman

The basic principles that govern the design and control of year 'round conditioning systems are organized and discussed in a systematic manner in the series of articles of which this is the first. No attempt is made to show a collection of control and equipment arrangements except insofar as they are needed to illustrate the various points discussed. Instead, the methods of accomplishing certain desired results in air conditioning systems and the broad basic principles that govern the applicability of different types of conditioning systems and controls are presented from a refreshingly new viewpoint. Those who are now designing and will be designing comfort air conditioning systems for postwar installation will find this discussion timely and practical, for no matter what the developments of the future, basic principles will always govern. Mr. Goodman is consulting engineer for the Trane Co., and is a member of Heating, Piping & Air Conditioning's board of consulting and contributing editors.

Most of the early comfort air conditioning systems were in spaces to be occupied largely by transients such as theatergoers. In theaters people are seldom in the conditioned spaces for more than a 2 or 3 hr period and then seldom more than once or twice a week. However, in the case of factories, hotels, office buildings, etc., people are in an air conditioned atmosphere for from 8 to 12 hr a day, day after day, throughout the year. Furthermore, many year 'round air conditioning systems have been and will be installed in windowless buildings or to eliminate the need for opening windows in existing buildings in noisy, dirty locations. Under these circumstances, much better air conditioning systems are required than the early ones that produced the cold, clammy atmospheres so prevalent even today in many of the older, lavish theaters.

When designing any air conditioning system, the equipment to condition the air and the controls to maintain desired conditions must be considered as an integral unit. Equipment cannot be selected without regard to the controls that will ultimately be used to maintain the desired temperatures and humidities. No control system can produce conditions in a space that the air conditioning equipment itself cannot produce when operated manually. All that the control system does is to control the conditioning media—steam, refrigerant, air, etc.—which produce the desired temperatures and humidities in the conditioned spaces. Obviously, the production of these temperatures and humidities depends solely upon the air conditioning equipment and not on the control apparatus.

When designing an air conditioning system, both the controls and the layout of the equipment and ducts must be considered simultaneously. A satisfactory year 'round system can be obtained only if equipment is selected in the light of the controls to be used and the controls are adapted to the equipment. An air conditioning system designed without thought to the controls and for which the controls are chosen only after all of the equipment has been selected and designed, has an excellent chance of proving unsatisfactory.

To many, *better* controls simply mean *more* controls and *more complicated* control systems. This is far from being the case. In many cases, the most satisfactory installations are those with relatively simple control systems without complications. Elaborate control systems are not always necessary for satisfactory control. Furthermore, because operators have difficulty in understanding the relationship between the parts of an elaborate control system, such systems may not give satisfactory results in actual operation over a period of years.

In this article an attempt will be made to discuss the principles involved in designing and controlling year 'round air conditioning systems. Refinements and details of control will not be discussed. Instead, the broad principles involved in designing air conditioning systems and selecting controls for them will be developed. The advantages and disadvantages of different arrangements of equipment and controls for the various types of air conditioning systems commonly used for year 'round service will be enumerated in order to provide a clear understanding of the results that can be expected from these systems and their controls.

There are, of course, many systems that can be used to condition different types of buildings and many types of control systems that can be used in conjunction with such conditioning systems. In this article it will be possible only to discuss broad principles and to use a few basic systems for illustrative purposes. The types of air conditioning systems and controls that are suitable for the great variety

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of buildings and operating conditions encountered is almost infinite. In discussing the basic principles and some of the fundamental systems, it is difficult at times to avoid a dogmatic tone. When applying the principles discussed here to the many conditions encountered in actual practice, exceptions may be found to some of the general principles stated. Nevertheless, a thorough understanding of the broad fundamentals underlying this subject should be of considerable help when designing air conditioning systems for particular installations.

The Importance of Humidity

One of the prime purposes of an air conditioned space is to keep the skin and clothing of the occupants of a room dry. To insure freedom from perspiration, humidities must be kept at a reasonable point. The exact humidity for optimum comfort and health to be maintained under all conditions is not known. However, general experience has shown that if comfortable dry bulb temperatures of 80 F or lower are maintained, relative humidities of approximately 60 per cent or less will generally be satisfactory.

In addition to keeping clothing dry, the relative humidity must be one that will produce a feeling of comfort for most of the people in the room. Formerly, it was thought that for each dry bulb temperature there was an optimum relative humidity at which most people would be comfortable. However, it is now known that human beings are rather insensitive to wide variations in relative humidity. Thus, the following statement appears on p. 67 of the ASHVE's Heating, Ventilating, Air Conditioning Guide for 1943: ". . . In the comfort zone experiments of the ASHVE research laboratory, the relative humidity was varied between the limits of 30 and 70 per cent approximately, but the most comfortable range has not been determined. In similar experiments at the Harvard school of public health, the majority of the subjects were unable to detect sensations of humidity (i.e., too high, too low, or medium) when the relative humidity was between 30 per cent and 60 per cent with ordinary room temperatures, which is in accord with other studies."

The fact that the humidity can be varied widely is in accord with the common experience of most of us. As long as the dry bulb temperature is at a comfortable point, individuals are insensitive to wide changes in humidity. They are, however, sensitive to extremes—extreme dryness and extreme moistness. High relative humidities mean uncomfortable and disagreeable perspiration; low relative humidities mean an uncomfortable drying effect upon the skin and mucous membrane, although p. 67 of the 1943 Guide states, ". . . there is no convincing evidence that the increase of atmospheric moisture which can practically be introduced by humidification into the air of cool occupied rooms has any effect upon health and comfort." Nevertheless, those who have experienced both the extreme dryness of a heated apartment in winter and the humidified atmosphere of a home will testify to the better general all around physical feeling in the latter. Consequently, while the maintenance of an exact humidity is not important in a comfort installation, it is important to avoid extremely high humidities in summer and extremely low humidities in winter. In comfort air conditioning, humidity *limitation* is needed instead of humidity control.

In connection with humidification in winter, there is, of course, the problem of condensation on windows and in walls. Where structures have not been built to permit the maintenance of high humidities in winter, there is, of course, no alternative but to lower the humidity to avoid the nuisance and damage caused by condensation.

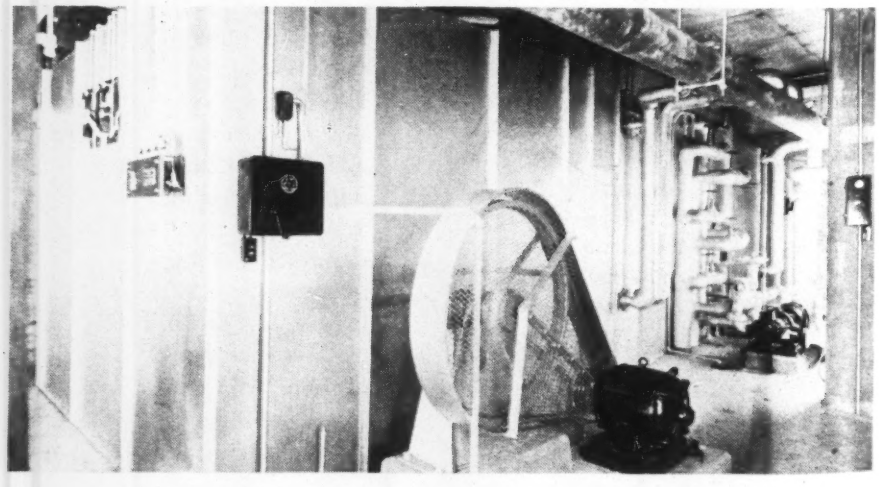
Industrial systems are, of course, quite different. In process air conditioning, both the relative humidity and dry bulb temperature must frequently be maintained at quite exact points. In such systems the relative humidity is determined by the requirements of the process or product and not from considerations of comfort. Usually the conditions under which the temperature and humidity must be maintained vary quite widely and more severely than they do in comfort installations. Methods of controlling temperature and humidity independently of each other will be discussed later in addition to controls for comfort.

Visualizing Changing Conditions on the Psychrometric Chart

The psychrometric chart is of value not only for designing air conditioning systems, but for analyzing the results that will be obtained with different types of air conditioning systems and controls under widely varying loads.

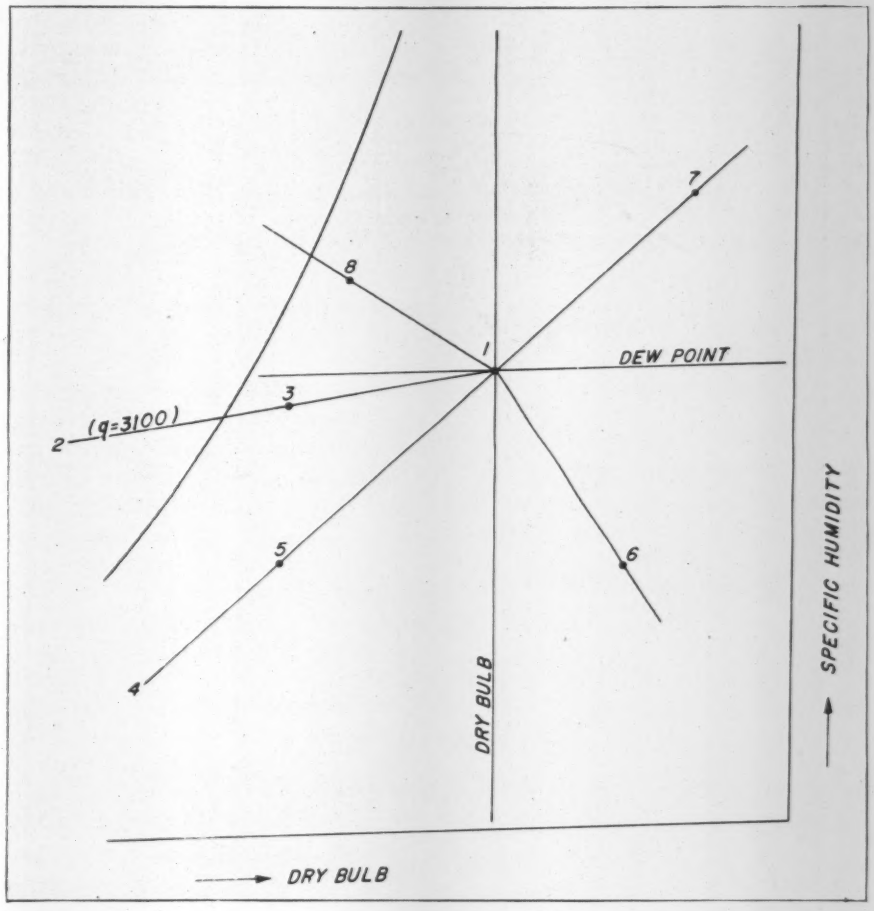
In winter the quantity of air to be supplied and its temperature are determined by the maximum heat loss from the conditioned space. For most comfort installations, a satisfactory humidity can be maintained during the winter with the air quantity selected in accordance with the heat loss.

In summer air conditioning, the quantity of air and its temperature cannot be selected quite so simply. The humidity to be maintained complicates the choice of the vol-



No control system can produce conditions in a space that the air conditioning equipment itself could not produce if it were operated manually

Fig. 1
The psych chart is of value not only in designing air conditioning systems, but also for analyzing the results to be obtained with different types of equipment under widely varying loads



ume and temperature of the air supply. The results that will be obtained in the room with an air supply at any given temperature and humidity depend upon both the *moisture ratio* and the volume of air supplied. The moisture ratio is simply the ratio of the total internal heat gain of the room to the moisture gain. (See HPAC, p. 360, June 1939 or p. 55 of the book, Air Conditioning Analysis.) The value of the moisture ratio q can be computed by the following formula:

$$q = \frac{Q}{W} + h_o \quad \ldots\ldots\ldots\ldots\ldots [1]$$

where Q represents the sensible heat gain of the room in Btu per hr; W represents moisture added to the room (the moisture gain) in lb per hr; and h_o represents the enthalpy or total heat of the moisture added to the room.

Of great value in determining the required condition of an air supply to maintain a given temperature and humidity in a room is the *ratio line* illustrated in Fig. 1. Point *1* represents the condition to be maintained in the room. Line *1-2* is the ratio line for the load of the room. The slope of the ratio line on the psychrometric chart (HPAC, p. 359, June 1939 or p. 109, February 1940) is determined only by the value of the moisture ratio.

The value of the ratio line lies in the fact that, in order to maintain point *1*, the condition of the air supply (that is, its temperature and humidity) must be represented by some point like *3* along ratio line *1-2*. An air supply state that can be represented by any point like *3* on the ratio line can maintain the room air in the condition represented by point *1*.

Slope of Ratio Line Changes

As the sensible and moisture gains change under various conditions throughout the year, the slope of the ratio line changes. The most severe condition is encountered when the moisture load is equal to the maximum and the sensible load is decreasing. In this case the ratio line swings from left to right to a position like *1-4*, or even *1-6* if the sensible heat gain should turn into a sensible heat loss from the room. Obviously, with any one room condition as a pivot point, the ratio line can, of course, swing through a complete circle of 360 deg. It can occupy any one of an infinite number of positions on the psychrometric chart, depending upon the relationship of the heat and moisture gains. The acid test of the ability of a year 'round air conditioning system to maintain a given condition in a room is its ability to supply air in a state that always lies on the ratio line regardless of the location of the ratio line itself.

The ratio line can be located on the psychrometric chart after first computing the slope of the ratio line. Thus, for a room in which the sensible heat gain is 16,000 Btu per hr and the moisture gain is 8 lb per hr, the moisture ratio is, by equation 1:

$$q = \frac{16{,}000}{8} + 1100^* = 3100$$

As has previously been stated, the slope of the ratio line on the psychrometric chart depends upon the value of the moisture ratio. The slope of line *1-3* in Fig. 1 corresponds to a moisture ratio of 3100 (see Table 32 on p. 441 of the book, Air Conditioning Analysis). Although for the conditions of Fig. 1 the maximum sensible heat load is 16,000 Btu per hr, the sensible heat load in most comfort air conditioning installations can vary considerably while the moisture load due to people remains approximately constant. This is particularly true of offices or factories where the moisture load is due altogether to the occupants. On the other hand, because of changes in the position of the sun, lowering of the outdoor dry bulb temperature, or a decrease in the electrical load in the room, the sensible load can vary quite widely.

Suppose that the sensible load of the room is decreased from 16,000 to 6000 Btu per hr while the moisture load remains constant at 8 lb

*In air conditioning work, for moisture added by human beings a value of h_o = 1100 Btu may be used.

per hr. In this case, the value of the moisture ratio will be reduced to

$$q = \frac{6000}{8} + 1100$$
$$= 1850$$

In this case the ratio line for the room will be represented by a line like *1-4* of Fig. 1 if the same temperature and humidity are to be maintained in the room. This is quite frequently the case when the variations in sensible load are due to solar heat gains and electrical apparatus. In this case it is obvious that, in order to maintain the condition represented by point *1*, the air supply must be in some condition like point *5* along line *1-4*.

Condition of Air Supply Must Be Changed

In all air conditioning systems where the moisture ratio of the room changes frequently, the condition of the air supply must constantly be changed if any desired condition is to be maintained in a room. In year 'round air conditioning it is possible for the ratio line to occupy any number of positions in the 360 deg circle. Thus, in spring and fall the ratio line may appear like line *1-6* of Fig. 1. In this case, little heat is required to keep the temperature of the room up, but at the same time some dehumidification is required to hold the relative humidity down to comfortable limits. Such a line is particularly likely to be obtained on rainy spring days. On such days the moisture load will increase while the sensible load decreases. For example, in department stores the building may be cooled by an all day rain while people enter the building continually with wet clothes and umbrellas. In such a case, both heating and dehumidification are required simultaneously, as exemplified by ratio line *1-6* of Fig. 1.

In winter the ratio line will appear like line *1-7* of Fig. 1. In this case the air must be supplied to the room in the condition represented by a point like *7*. The air in cooling from point *7* down to the desired condition at point *1* surrenders both heat and moisture, thus maintaining the temperature of the room and keeping its humidity up. In winter, of course, moisture is lost from the conditioned spaces and the air supply must bring in enough moisture to maintain the desired humidity.

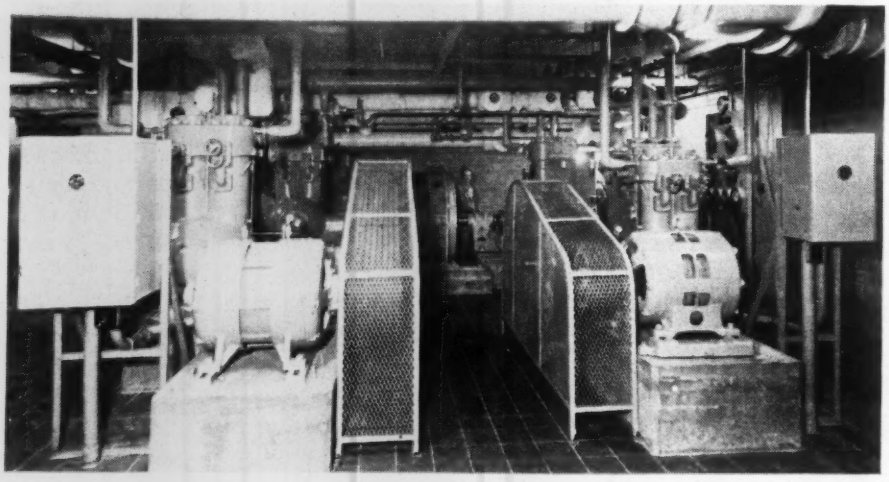
A condition rarely encountered in comfort work but which may be encountered in industrial work is represented by line *1-8* of Fig. 1. In this case, simultaneous cooling and humidification of the conditioned space is required. The air supply is delivered to the room in the condition represented by point *8*. As the dry bulb temperature of the air rises from point *8* to point *1*, the heat gain of the room is absorbed. On the other hand, while changing from point *8* to point *1*, the air supply gives up sufficient moisture so that its dew point temperature is reduced, thus maintaining the desired humidity in the room.

What the Controls and Equipment Must Do

The conditions under which air conditioning equipment is required to operate in year 'round air conditioning systems have been described in a general way in the foregoing paragraphs. Any equipment and controls installed must be able to maintain the temperature at any desired point and the relative humidity within certain limits for all of the different ratio lines that are likely to be encountered throughout the year. Only in the operation of controls and equipment is analyzed in the light of their ability to maintain a given set of conditions for any ratio line that is likely to be encountered can a satisfactory system be obtained.

The fact that humidities need not be controlled exactly in comfort installations does not mean that the humidity problem can be overlooked. Even though the humidity is not to be controlled exactly but is only to be held between rather broad limits, the system installed should be an inherently stable one—that is, one that can provide air in a state on any ratio line likely to be encountered. If an unstable system is installed, it will be difficult to obtain satisfactory temperatures and humidities in the conditioned spaces under all conditions of load in spite of the fact that the humidity need not be controlled exactly. Consequently, systems should be fundamentally designed and installed in such a manner that they will be stable under all conditions of operation.

In following sections of this article, systems and controls will be described for meeting widely varying conditions. Air conditioning systems capable of providing air that will meet the requirements of almost any ratio line will be considered. Before describing such systems, however, a few of the commonly used systems and their shortcomings will be discussed so that the reader will better understand the reasons for some of the apparent departures from conventional practices in the year 'round systems to be discussed later.



The equipment to condition the air and the controls to maintain the desired conditions must both be considered as an integral unit by the designer

DAILY SUMMARY
BOILER HOUSE OPERATIONS

Date	Degree Days	Average Temperature	Maximum Temperature	Minimum Temperature	Mean Temperature

Boiler House	Actual Oil Consumption gal	"Normal" Oil Consumption gal	Deviation from "Normal"	"Normal" Deviation	Deviation Ratio	Feedwater Used gal	Average Boiler House Efficiency	Boiler Hours	Per Cent of Boiler Rating	Remarks
				Median Daily Ratio						

HOW TO WATCH FUEL USE

The Daily Report

Fig. 1 (Above)—The consumption report form, providing space for all significant data and computations. This form is filled out each day as quickly as possible, and any unusual ratios are underlined and steps taken to determine the cause of abnormal fuel use

BY PLOTTING daily fuel consumption during a representative or basic period against temperature deficiency as measured by degree days the dependency of fuel consumption upon the outside temperature is shown. This relationship can be described by a smooth curve which represents average or "normal" fuel consumption, as explained last month.

The deviations of actual consumption from "normal" consumption during the basic period can be described by an average or "normal" deviation. The actual deviation can be compared to this "normal" deviation in the form of the deviation ratio, the actual deviation divided by the "normal" deviation, a figure which allows unit to unit and day to day comparisons of performance.

In order to facilitate boiler house to boiler house comparisons of daily performance a daily report form, Fig. 1, has been devised, which permits listing of the actual daily oil consumption, the "normal" oil consumption for that day, the deviation from "normal," the "normal"

W. S. Bard, author of this article, has done a great deal of work in applying statistical methods to steam and fuel consumption studies and control, and will be remembered for discussions of the subject published in HPAC in 1937. During the period when the work described in the present article was performed, he was employed in the steam generation and distribution section at a large ordnance plant, and the method he discusses is in daily use at this plant . . . Careful control of fuel and steam consumption for heating plants and buildings is always good business; in wartime, it becomes of increased importance because of the greater necessity for efficient production and operation, conservation of fuels, and because of fuel oil rationing restrictions.

deviation, and the deviation ratio for each unit and the total area. Space is provided at the top of the form for inserting the significant daily temperatures and at the bottom for inserting the median daily deviation ratio.

Fluctuations in actual consumption from "normal" might be considered as being due to fluctuations in the non-heating load. However, when the daily reports over a period of time were studied it was found that the direction of the fluctuation, positive or negative, and the relative size of the fluctuation, as measured by the deviation ratio, tended to be about the same each day for all operating units (Fig. 2). Since it was not logical to suppose that the non-heating load fluctuates in a corresponding manner in all units at the same time, this fluctuation was concluded to be due to fluctuation in the actual heating load. Next to temperature, wind velocity is considered as the most important factor affecting the heating load. Records of average daily wind velocity were obtained from the weather station and compared with the daily deviation ratio for the total area but no significant correlation was found.

If the daily deviation ratio for a typical unit and the daily degree days are plotted historically on the same graph (Fig. 3) a clue to the reason for the fluctuation may be found. It is noticeable that the fluctuation in size of the deviation ratio and the fluctuation in the number of degree days are somewhat related. The greater the fluctuation in degree days, the greater the fluctuation in size of the deviation ratio. When the number of degree days increases (weather gets colder), the size of the deviation ratio moves negatively. When the number of degree days decreases (weather gets warmer), the size of the deviation ratio moves positively. This holds true a high percentage of the time.

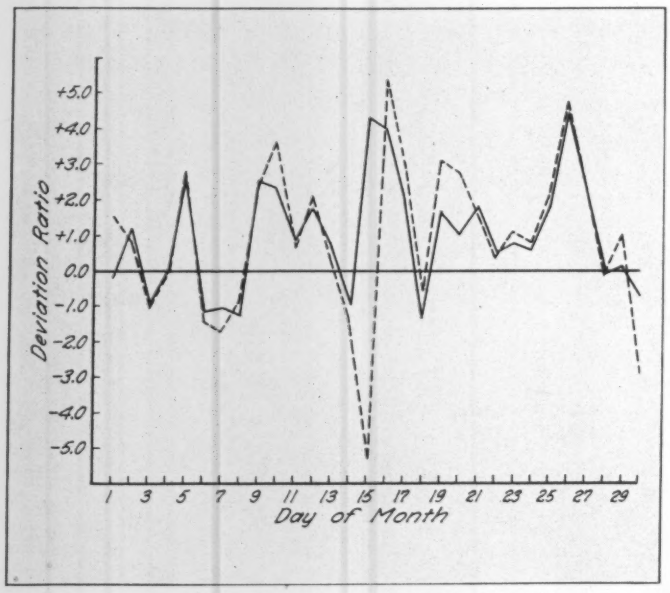


Fig. 2—Comparison of the daily deviation ratios for two typical units. Note how closely together lie the ratios for these units. Only on one day, the 15th of the month, are the ratios significantly separated. Comparison of these ratios with the ratios for other units shows which is abnormal

Oil Consumption Tends to "Cut the Corners"

This can be better illustrated by plotting actual and "normal" oil consumption historically (Fig. 4) for a typical unit. It can be noted that actual oil consumption tends to "cut the corners"; that is, the peaks and valleys in actual consumption are not as extreme as the peaks and valleys in "normal" consumption when plotted in this manner. From these facts the following was deduced:

The heating load for any given day is determined not only by the outside temperature for that day but also by the temperature of the preceding day or days. In general, when the temperature of the given day is colder than the preceding day the heating load as reflected by the amount of fuel consumed will be less than "normal," and when the temperature of the given day is warmer than the preceding day the heating load will be greater than "normal".

This was thought to be primarily due to the nature of the heating control in the buildings. Most of the buildings are heated by steam radiation and there is no automatic control of this radiation. The maintenance men and the occupants of the buildings open and close the radiator valves more or less as their feelings may dictate. During cold weather most of the radiators are turned on. When it gets warmer, the radiation is not turned off quickly enough, the buildings become overheated, windows and doors are opened, heat is wasted, and excessive consumption results. During mild weather most of the radiators are shut off. When it gets colder the radiation is not turned on quickly enough, the building temperatures drop, doors and windows are kept closed, and oil consumption is less than "normal". When the temperature remains fairly stable over a period of several days the consumption remains relatively close to "normal". This theory later became the basis of a conservation program aimed at reducing the waste on days that were warmer than their predecessors.

The most notable exception to the action described above occurs on days that are a great deal colder than the preceding days. On days when the average temperature drops 12 deg or more below the average temperature of the preceding day, the radiation is turned on quickly and consumption is close to or slightly above "normal". There was also traceable a slight correlation between the exceptions to the above action and wind velocity. On days which were colder than the preceding days with consumption above "normal" the average wind velocity was generally high. The evidence supporting this latter statement cannot be considered conclusive.

The fact that the size of the average or "normal" deviation is related to the slope of the "normal" curve supports the claim that the deviations are caused principally by fluctuations in the heating rather than the non-heating load. This

conclusion is also supported by the fact that the "normal" non-heating deviation is considerably less than the "normal" heating deviation.

The "normal" or average oil consumption and the "normal" or average deviation during the basic period may be considered to be representative of the performance to be expected during succeeding periods. The daily reports for these succeeding periods may be interpreted on the basis of the above conclusions. In general the ratios of all units move in the same direction from day to day and tend to be more or less the same in size. The ratios tend to lie within a range of 1½ on either side of the median ratio for all units. Thus, on a given day the median ratio for all units may be —1.5. Any ratio between —3.0 and 0.0 may be regarded as being satisfactory. But if one unit has a ratio of +1.0, consumption is excessive for that day in that unit. Similarly, if the median ratio is +2.0, ratios within the range of +0.5 to +3.5 may be regarded as satisfactory, while a ratio outside this range can be considered a significant departure.

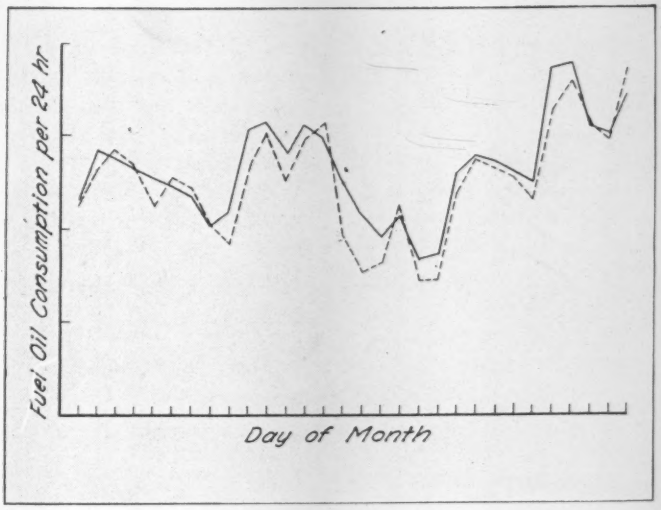


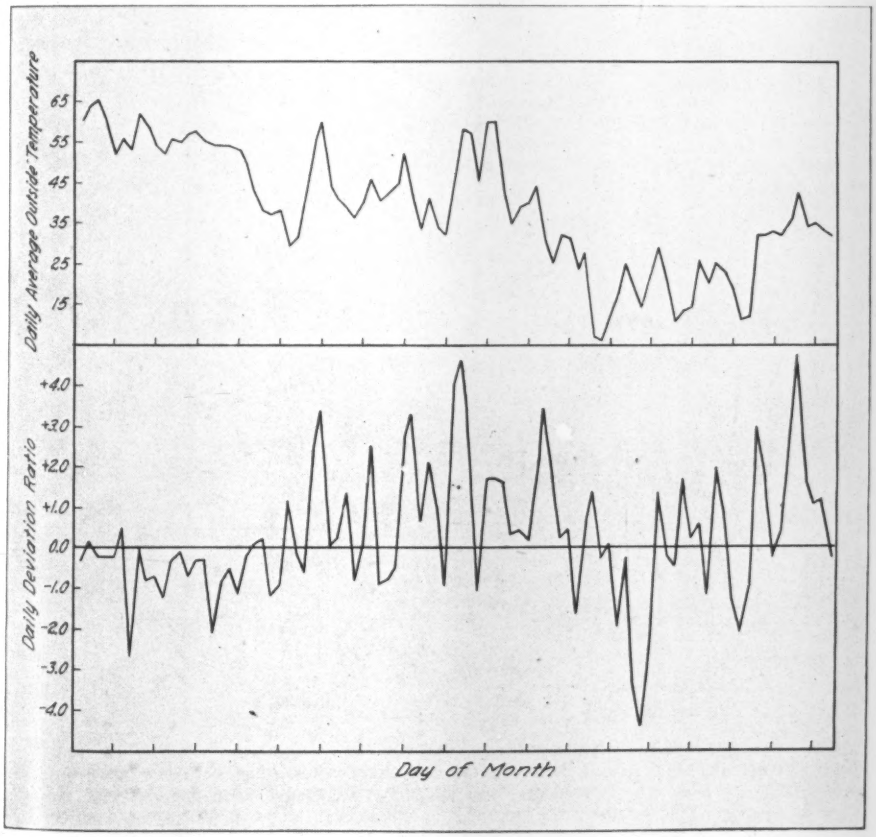
Fig. 4—Comparison of actual and "normal" daily fuel consumption for one month. The solid line represents actual fuel consumption, the dotted line "normal" fuel consumption, for a typical unit. Note that the fluctuation in actual consumption is not quite as great as the fluctuation in "normal" consumption, indicating the lag between changes in the outside temperature and the adjustment of the unit's heat use to the outside temperature

Boiler House Efficiency

The daily report form also contains space for the inclusion of the daily feedwater consumption and the hours of boiler operation for each boiler house. From the daily feedwater consumption and daily oil consumption it is possible to compute the average boiler house efficiency; that is, the ratio of heat generated by the boilers as determined from the amount of water evaporated to the heat input as measured by the oil consumed. Water used for boiler blowdowns is not deducted from the feedwater consumption figures, but this error is counterbalanced by the gain from injector testing and the tendency of the meters to make a constant negative error. The correlation between the amount of feedwater consumed and the amount of oil consumed is very high, indicating that the errors caused by these factors are not very large. The efficiencies as computed may be considered to be accurate within a very few per cent, and *relatively* accurate from day to day; i. e., a decrease or increase in computed efficiency may be considered to indicate a decrease or increase in actual efficiency. These average efficiencies are computed each day and entered on the daily report.

It is possible to compute the boiler horsepower generated from the figures on feedwater consumption and hours of boiler operation. The boiler horsepower generated may be compared with the rating of the boilers to obtain the average percentage of rating at which the boil-

Fig. 3—Comparison of the fluctuation in the daily deviation ratio for a typical unit and fluctuation in the daily average outside temperature, for a three-month period. Note that in general the greater the fluctuation in temperature, the greater the fluctuation in the deviation ratio, and that the two curves tend to move in the same direction—when the weather gets colder, fuel consumption tends to be below "normal," and when the weather gets warmer, the fuel consumption tends to be above "normal"



ers are operated during the daily period. The average percentage of rating is computed each day and entered in the report.

As might be expected, the average boiler house efficiency was found to be related to the average percentage of rating at which the boilers were operated. In general the higher the percentage of rating at which the boilers are operated, the higher will be the average efficiency attained. The point of decreasing efficiency with increasing percentage of rating is seldom if ever reached, as the boilers are rarely operated over 100 per cent of rating.

This explains in part the curvature of the "normal" curves. The efficiency of steam generation does tend to be lower when the load is light than when the load is moderate and does tend to increase when the load is heavy.

The feedwater meters do not register correctly under light loads. In order to check boiler operation when these readings are not available, the average rate of oil consumption per boiler hour is computed each day for each unit and entered in the report. This rate is related to the average percentage of rating at which the boilers are operated which in turn is related to the average efficiency.

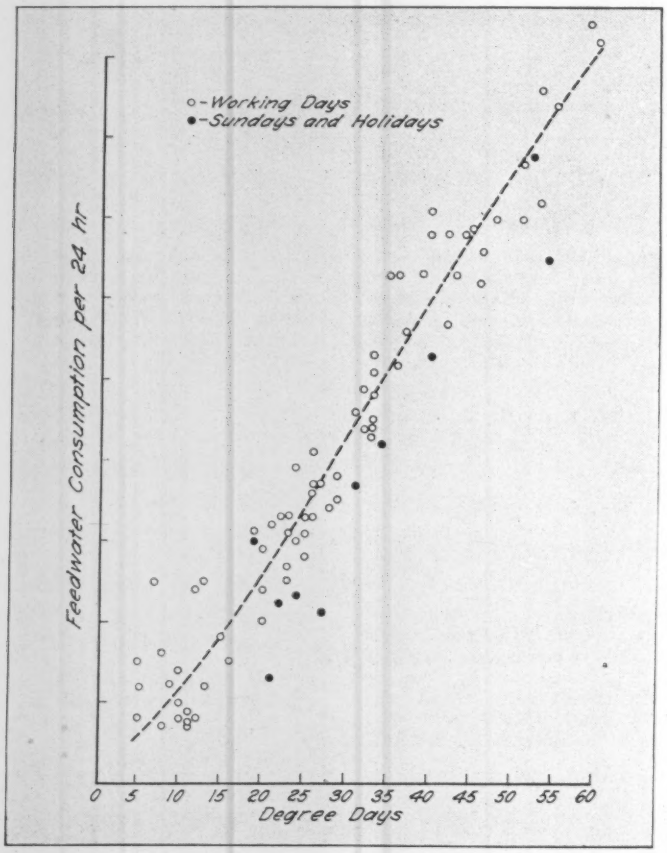


Fig. 5—Daily feedwater consumption plotted as a function of daily degree days, for the period from September 20 to December 31, 1942. Note that the "normal" curve describing this relationship is similar to the "normal" curve for fuel consumption. Observations for days on which feedwater consumption was below the accuracy range of the meter have been omitted

The boilers were found to be operating at between 65 and 80 per cent average daily efficiency most of the time, at an average daily percentage of rating of from 65 to 95 per cent. It was found that daily average efficiency of 75 per cent could easily be maintained at 80 per cent of rating. This was a rate of oil consumption of about 75 gal per boiler hour and a rate of feedwater consumption of about 1000 gal per boiler hour. These figures serve as a guide to boiler operation and to the interpretation of the daily report.

Deviations of actual consumption from "normal" might also be considered to be due to fluctuations in average boiler house efficiency. In order to measure the load without the effects of fluctuations in the efficiency of steam generation the daily amount of feedwater used may be plotted against degree days and subjected to the same treatment as the oil consumption data.

Since the feedwater meters are not as accurate as the oil meters and since feedwater meter readings were not available for days with light loads the records were not complete for all units. Feedwater consumption for one unit with fairly complete records was plotted against degree days and a "normal" curve was drawn and the "normal" deviation computed (Fig. 5). The daily deviation ratios for feedwater consumption during the basic period were computed and compared

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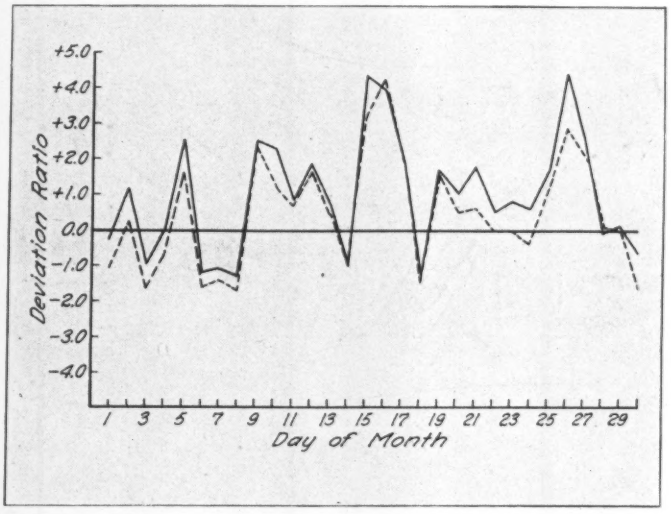


Fig. 6—Comparison of the daily deviation ratios for oil (solid line) and feedwater (broken line) consumption for one month. Note that the curves lie fairly closely together, and fluctuate in the same direction and by nearly the same relative amount, indicating that the fluctuation in the efficiency of steam generation was not extreme throughout the month

Selection of the Right Pipe for POWER PIPING SYSTEMS

A. C. Kirkwood, of Burns & McDonnell Engineering Co. (consulting engineers), a member of HPAC's board of consulting and contributing editors, discusses here pipe selection for power piping systems in accordance with the American Standard Code for Pressure Piping. After considering briefly the general conditions surrounding selection of the desirable pipe material and the correct wall thickness, he presents four charts which may be used to simplify preliminary studies of the problem and reduce the amount of time required for them. The methods described have been used on a number of important power piping projects.

SELECTION OF appropriate pipe materials and the determination of wall thickness have been reduced to a practical and workable basis, thanks to the efforts of many men and their organizations. The knowledge they have accumulated and analyzed has been pooled for the benefit of all and this collective information has been condensed into workable, commercial form by the American Society of Mechanical Engineers, the American Standards Association, the American Society for Testing Materials, and other such groups.

The American Standard Code for Pressure Piping, ASA B31.1—1942, is the printed authority for minimum safety requirements for pressure piping design and erection. By means of inclusion of and references to ASTM specifications, this code also determines the selection of suitable materials. It contains references to standard specifications by which the materials may be secured.

It is the function of the code to present requirements in a formal although intelligible manner. This has been done, but the wealth of information leaves no room and little opportunity for the quick comparisons so much desired by many engineers.

Many such comparisons and ready references have been prepared. The author has found the graphical data of this article to be quite useful. It should be recognized that numerical data read from the charts lack the accuracy of actual calculations, but many sets of calculations can be eliminated by making preliminary selections from the charts. By this method, detailed calculations are required only for those selections deemed most applicable.

Essentials of Pipe Selection

It is undoubtedly appropriate to consider briefly the essential requirements of the selection of pipe materials and the determination of wall thickness.

Temperature of the pipe contents determines the suitability of materials. Thus, the code limits certain nonferrous materials to 350, 400, or 450 F, as the case may be. Some ferrous materials are limited to temperatures of 450 F, others to 750 F, and still others to 950 or 1000 F. Certain alloys are not economically applicable to the lower temperature ranges and their use for these conditions should be frowned upon as an economic waste unless other operating requirements demand their use. The allowable stress (S) at operating temperature and its change with change of temperature are the indices determining the limitations imposed on the use of various pipe materials.

Obviously, the required pipe wall thickness varies inversely with change in allowable stress. The code prescribes that the minimum wall thickness shall equal the maximum internal service pressure times the outside diameter of the pipe, divided by twice the allowable stress—to which calculated thickness must be added an arbitrary allowance for threading, mechanical strength, and/or corrosion. All formula units are in terms of inches and pounds and the formula is

$$t_m = \frac{PD}{2S} + C$$

For plain end steel or wrought iron pipe or tube for sizes above 1 in., the factor C is 0.065 in. Commercial wall thicknesses are increased by an amount equivalent to the manufacturing tolerance; this is usually 12.5 per cent of the commercial thickness.

It is essential that the number of available wall thicknesses for each nominal size of pipe be limited to those values that will result in simplified manufacturing procedure without unnecessary waste of materials. In recent years, the entire piping industry has accepted as standard the use of the "schedule number" system. In this system, the schedule numbers approximate values for the expression $1000 \times P/S$—one thousand times the service pressure divided by the allowable stress.

Schedule numbers 40 and 80 are the most widely used, particularly in sizes 6 in. and smaller. In this range they have the same wall thicknesses as the old "standard weight" and "extra strong" pipes.

Quick Reference Charts for Preliminary Studies

The preceding paragraphs describe very briefly the general conditions surrounding the selection of desirable pipe material and wall thickness. As previously stated, the specifications and codes cannot and do not provide a quick reference and comparison of the several materials. It is the intention of the following paragraphs and the accompanying charts to provide a

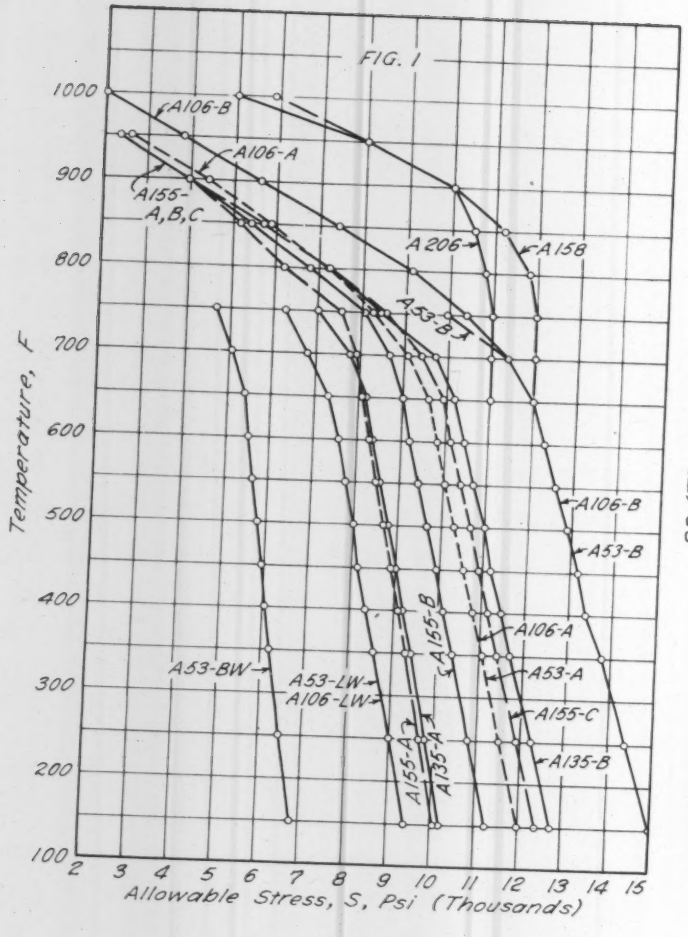


FIG. 1
Temperature, F
Allowable Stress, S, Psi (Thousands)
A106-B
A106-A
A155-A,B,C
A206
A158
A53-B
A106-B
A53-B
A106-A
A53-A
A155-C
A135-B
A53-BW
A53-LW
A106-LW
A155-B
A155-A
A135-A

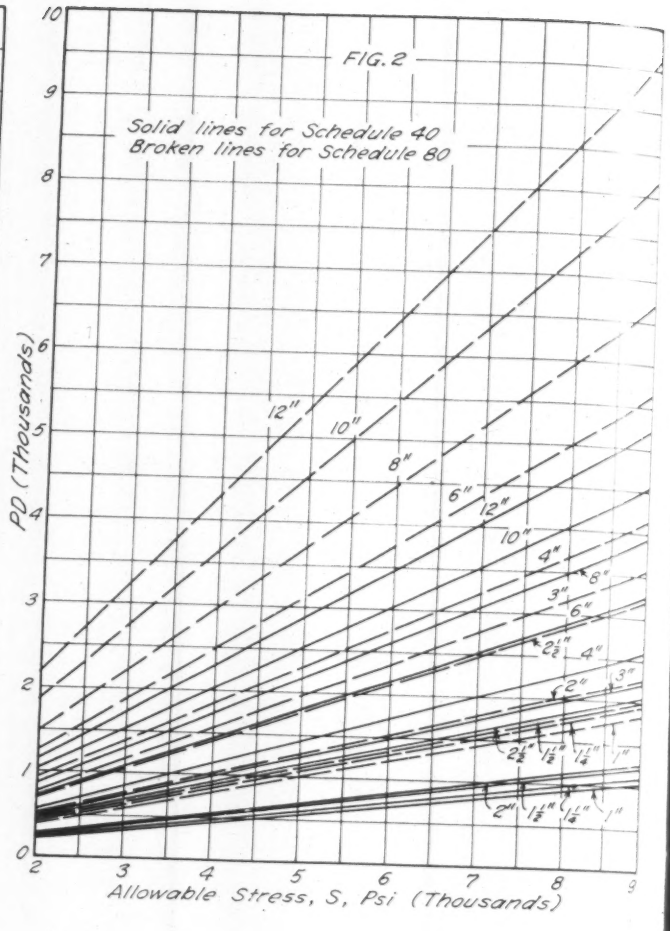


FIG. 2
Solid lines for Schedule 40
Broken lines for Schedule 80
PD (Thousands)
Allowable Stress, S, Psi (Thousands)

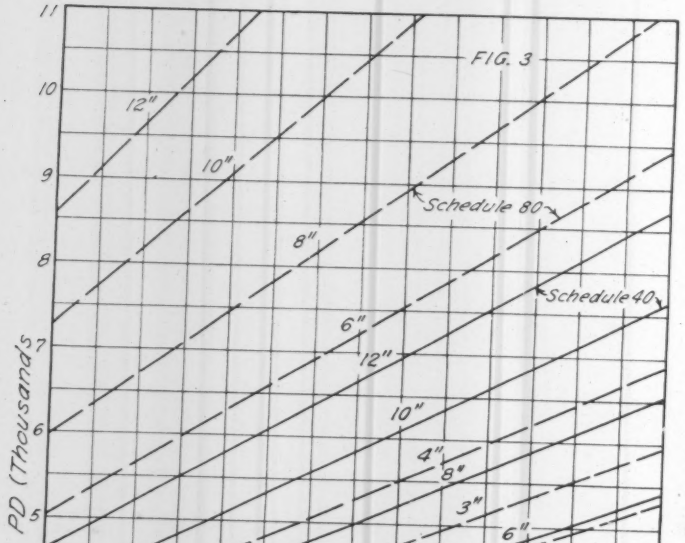


FIG. 3
PD (Thousands)
Allowable Stress, S. Psi (Thousands)
Schedule 80
Schedule 40

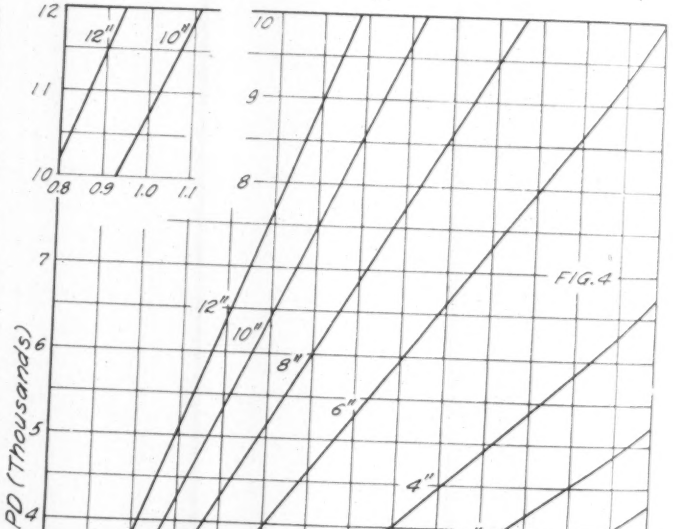


FIG. 4
PD (Thousands)
Maximum Internal Service Pressure, P, Psi (Thousands)

helpful and easy reference that will decrease the time required for preliminary studies.

The formula given below is based upon the code formula previously discussed. It has been modified by inclusion of t_t, to show 12.5 per cent tolerance in wall thickness, and t_a, to show actual thickness designated in the table of schedule numbers.

$$t_a = t_m + t_t = \frac{PD}{2S} + C + t_t$$

from which

$$t_a - (C + t_t) = \frac{PD}{2S}$$

For each schedule number and diameter of pipe, the values of C and t_t are known. The term C is 0.05 in. for 1 in. and smaller diameters and 0.065 in. for diameters above 1 in. for plain end steel or wrought iron pipe. The term t_t is usually 12.5 per cent of the commercial or nominal thickness. Deduction of the sum of these allowances leaves the calculated thickness (t_c) of the wall and the formula can be restated:

$$t_c = \frac{PD}{2S}$$

This thickness represents the amount of the total wall thickness that is available under all circumstances to resist the applied pressure at the operating temperature.

The value of S (allowable stress) is a function of temperature. Tables 3 and 3_a of the Code for Pressure Piping list the allowable maximum values for power piping for each of several temperatures and the several types and grades of pipe may not be used for temperatures in excess of the maximum temperatures for which S values are listed. Fig. 1 (herewith) is a graphical presentation of these tables insofar as the more common steels are concerned. Values from the table are represented by dots and they are connected by straight lines, since the code permits interpolations.

Figs. 2 and 3 show, for 1 in. to 12 in. diameter pipes, the relation between S and PD for schedule 40 (solid lines) and schedule 80 (broken lines) pipe in the range of 2000 to 15,000 psi for S and 0 to 11,000 for PD.

Fig. 4 shows for the same diameters the relation between PD and P for the ranges 0 to 10,000 PD and 0 to 1500 psi for P. Slightly greater ranges are shown for 10 and 12 in. diameters in the inserted graph of Fig. 4.

The charts may be used in several ways, the principal one being in the selection of materials. For example, 450 psi, 750 F steam is to be transported in such quantity and for such distance that a 6 in., schedule 40 pipe is required. Fig. 4 shows that the PD value is approximately 2950. Fig. 2 shows the required S value to be at least 8250. In Fig. 1 the intersection of values of 8250 for S and 750 F is found to be beyond the limits of such materials as A-53 butt and lap weld, A-106 lap welded, and A-135 grade A. It is right on the limit for A-106 grade A seamless, and A-53 grade A seamless. All other materials shown on the chart are permissible.

Using the charts in the reverse order, it is possible to determine the pressure limitation for a particular material used for any diameter. Assume that the contents of the pipe will have a maximum temperature of 300 F and it is desired to use A-106 grade A seamless pipe. The maximum S value according to Fig. 1 is 11,300. For an 8 in. schedule 40 pipe the corresponding PD value is 4900 and reference to Fig. 4 shows that the maximum permissible pressure is about 570 psi.

Symbols

t_m = minimum pipe wall thickness, inches;
P = maximum internal service pressure, pounds per square inch;
D = outside diameter of pipe, inches;
S = allowable stress in material due to internal pressure, at the operating temperature, pounds per square inch;
C = allowance for threading, mechanical strength, and/or corrosion, inches;
t_t = term introduced to show tolerance in pipe wall thickness, inches;
t_a = actual pipe wall thickness designated in table of schedule numbers, inches;
t_c = calculated pipe wall thickness, inches.

In Fig. 1, the legends on the curves designate the various ASTM specifications for pipe and their various grades (A, B, C). "LW" means lap welded and "BW" means butt welded.

How to Watch Fuel Use

[*Concluded from page* 128]

with the daily deviation ratios for oil consumption (Fig. 6). The following was noted:

1) The size of the average or "normal" deviation in feedwater consumption as compared with the slope of the "normal" curve of feedwater consumption was approximately the same as the size of the "normal" deviation of oil consumption as compared with the slope of the "normal" curve of oil consumption. In other words, the fluctuations in load are neither more nor less extreme than the fluctuations in oil consumption.

2) In general the size and sign of the individual daily deviation ratio for feedwater consumption tends to be approximately the same as the corresponding ratio for oil consumption.

3) The variation in average boiler house efficiency is not great enough to appreciably affect the size of the ratios except on unusual occasions.

First Steps in a Conservation Program

The first steps in a conservation program should be aimed at increasing the average efficiency of steam generation and at decreasing the heating load by the prevention of waste due to high building temperatures. If such a program is inaugurated in one unit the results will become immediately apparent in the daily report, as the deviation ratio for that unit will drop below the ratios for the other units and tend to remain below them. However, these results can be more accurately measured over a period of time. This is done by totalling the daily data and arriving at an average, as will be explained in the next article of this series.

SAM LEWIS' PAGE

Samuel R. Lewis, Consulting Engineer and Member of HPAC's Board of Consulting and Contributing Editors, Takes More Than His Usual Page This Month in Order to Discuss

Location of Exhaust Air Grilles

QUESTIONS HAVE been asked concerning the wisdom of the present apparent tendency by ventilating engineers toward provision for elaborate distribution, in large rooms, of the air supply, with exceedingly rudimentary location of the outlets from such rooms for the spent or return air. It is said to have become almost an axiom in the design of plants which use refrigerated air for summer cooling, to place a single return air opening at any convenient place near the floor along one of the walls and to make this single grille serve the entire ventilated place. There is a good excuse, then, to take at least a conservative issue with this axiom, and there is justified some constructive criticism of the single return opening, especially with all-blast heating systems. The following experiences come to mind:

In a large and long St. Louis general office, the main air supply duct was installed overhead, with many horizontally discharging diffusing grilles along its sides, pushing the air toward the exposed walls. A single return grille was placed near the floor at one end of the room. It was found in both summer and winter that the employees within a radius of perhaps 10 ft of this grille complained of too strong air movement, and in winter as a self defense measure against unbearable drafts around their legs, the employees had closed off the return air grille.

In another case the 22,000 sq ft equilateral basement of an air conditioned department store in Indianapolis had inlets with platter type diffusers. These inlets were supplied from overhead ducts about 20 ft apart, evenly disposed over the entire area. There was a single very large return air grille near one corner of the room passing about 30,000 cfm of air. Since no one was compelled to sit near the return air grille, there was no complaint of drafts but, as in most department store salesrooms, all the wall space was valuable for display racks. It was the established custom to hang on a long bar close to the return air grille, perhaps 100 women's dresses. The manager complained about the serious and continued soiling of this merchandise, and could not understand why such local damage should occur. It developed that the rapid air current going to the grille, which was 10 ft long and 5 ft high, was depositing on its way out much of the dust which had been carried into the room by the customers. The dresses had become air filters.

Back about 1866 Henry Ruttan, a Canadian engineer and inventor, developed a horizontal sectional cast iron furnace, the principles of which endure to this day. He also developed a fairly successful arrangement for heating a railway coach from a jacketed stove at one end, far in advance of the previous scheme of merely having an ordinary stove at one end, and long before the days of vapor car heating by the steam from the locomotive.

No one had thought at that time about using fans for distributing the warm air from a furnace or stove, probably because there was no power supply for running such a fan.

Mr. Ruttan's scheme was to distribute the heat by aid of special underfloor return air ducts so that the jacketed stove received the air that was to be warmed, by way of wooden ducts which received the cool air at the floor level through many small openings along the sides of the car. The joists of the floor were overlaid at right angles by transverse auxiliary joists, so that free air circulation was possible in every direction between these joists, the floor, and a wood bottom under the joists. Of course the end of the car most remote from the stove was essentially colder than the end near the stove, but conditions were so much better than with the earlier practice that people used to write the Canadian Pacific to learn on what days the Ruttan heated cars would be used, and to arrange their trips accordingly.

Mr. Ruttan then applied his scheme for distributed return or ventilation openings to school rooms, and during many years hundreds of school buildings throughout the United States were heated and ventilated after his teachings. For each two superimposed class rooms there was a single large furnace arranged to receive air supply directly from outdoors. A large masonry flue extended directly from the masonry furnace casing up to each room, on the interior wall opposite the major window exposure, and the air from each flue entered the room near the floor.

Usually a collapsible and removable metal shield was furnished to divert the stream of hot air from the unfortunate youngsters who must sit near the inlet. A single

blade damper, operated by chains and a crank in the school room, permitted the introduction of warm air or cold air which bypassed the furnace, or allowed any desired mixture of the two air streams. The floor joists had 2 x 4 in. transverse joists above them. Under each window there was a baseboard grille about 30 in. long and 4 in. high which communicated with the underfloor air passages. Wood studding, without cross bracing so as to permit air passage between the studs, connected the second story joist spaces through the first story.

In the basement, lath and plaster ducts along the ceiling connected these downcomers and the first story joist spaces with small rooms which opened into great masonry chimneys. In the base of each such chimney, which might serve four or even six classrooms, there was a small coal fired furnace called a stack heater, around which the spent air, called "foul" air, was warmed and so created a strong draft.

As far as thermal air circulation at low velocities could go, this system of heating and ventilating a schoolroom did an excellent job, and was the pioneering research which developed modern continuous ventilation, automatic temperature control, and all-blast heating. Mechanical ventilation for public buildings using steam was developed largely from the competitive incentives started by Henry Ruttan.

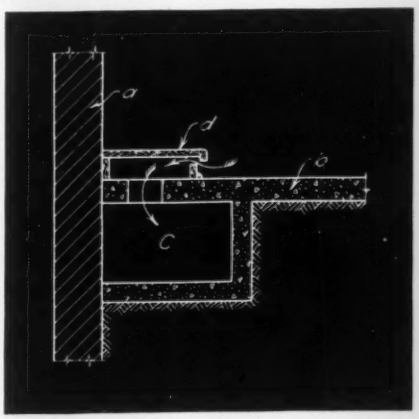
The scheme of vent ducts between and over and across the wooden joists and down the space between the wooden studs eventually was condemned. Occasionally a school building caught fire. The big heated vent stacks carried away the smoke and induced a roaring draft of air to support any fire that reached the wooden airways. The joists could be burned through and the floor could be ready to fall without any particular evidence in the classroom that the building was on fire. Any school house that was ignited was pretty sure to burn down. The firemen have been known to leave a building, believing that the fire was out, while it was burning fiercely in the interjoist spaces.

There would be an occasional classroom, with the Ruttan system, in which the distribution of the warm air seemed imperfect. The standard remedy in such cases was to cut in an additional vent base, so as to withdraw the cool air from floor level in the cold zone, thus to encourage its replacement with warmer air.

Recently, owing to war restrictions, many large stores in the community buildings of war housing projects have been heated by the great grandsons of Henry Ruttan's horizontal sectional cast iron furnace. In these projects it has been necessary to use cement-asbestos or similar air supply ducts. Electric fans furnish the pressure for moving the air. The most successful rooms of this type, many having more than 10,000 sq ft of floor area, have inlet diffusers well distributed, usually from overhead ducts near the glass and exposed wall areas, with similarly distributed return air grilles close to the floor along the sides of the rooms most remote from the inlets. Some arguments by the designers were needed to obtain the necessary masonry return air ducts, but the results have justified the arguments.

One especially satisfactory scheme, to prevent closure of the return air grilles by over zealous store managers with their display cases, is to build an overhanging eave-like cover which conceals a continuous slot through which the air may leave the room, as indicated in the accompanying illustration.

Continuous slot used in stores through which air may leave the room. *a* represents an outside wall or a partition between large rooms, *b* is a concrete floor on the ground, *c* is a concrete return air duct leading to the suction side of the supply fan, and *d* is a wooden bulkhead (say 6 in. high) upon which the store manager may build his cases, racks, etc. The arrows indicate the direction of the air flow



The slot may be any desired width, say 1½ to 2 in. Few store managers realize that openings of this type are present. The War Production Board is pleased that there are no metal grilles required. If mice are feared a screen can of course be placed horizontally under the "eaves."

All of this is intended to be a conservative issue-taking in favor of the use of many well distributed return air or spent air openings in large rooms heated or cooled when air is used as the carrier.

The St. Louis example was corrected by installing three more return air grilles. The Indianapolis example was redesigned to give a circular air supply diffuser in the center of every construction bay, discharging radially, with a return air grille in the center of every diffuser, receiving its air vertically. This scheme is eminently satisfactory. They cannot very well obstruct these openings with ladies' dresses.

HEATING AND VENTILATING AT A NAVY TORPEDO PLANT

The heating, ventilating, and air conditioning installations at the Amertorp Corp. U. S. Naval Ordnance torpedo plant, Forest Park, Ill., were described in an article by Robert V. Mehaffey published on pp. 84-87 of the February 1944 HPAC.

This project was designed by Albert Kahn Associated Architects and Engineers, Inc. R. C. Weiboldt Co. was the general contractor, M. J. Corboy Co. was the heating and plumbing contractor, and the ventilating contractor was the Haines Co.

FORESEES 8 PER CENT MORE JOBS WHEN WAR WORK ENDS

Janesville, Wis., the first predominantly industrial city in the nation to complete a company-by-company estimate of its industrial and commercial employment after the war, foresees 8 per cent more jobs when war orders cease than during its present period of peak production. Figures on this survey were released last month by the Janesville Committee for Economic Development through the national office of the CED in New York City.

Big Need for Air Conditioning, Heating, and Piping Equipment When War Ends Seen

Postwar plans being made now make the future of air conditioning loom bright, says T. W. Reynolds, who predicts that wartime experience with process and comfort air conditioning—or the lack of it—is creating a big demand for these services. In addition, many heating, piping, and air conditioning systems—installed under wartime restrictions and with second hand or substitute materials—are going to need replacement and modernization. It all adds up to a big demand for heating, piping, and air conditioning equipment, he feels. . . . Mr. Reynolds has been closely connected with the wartime regulations governing installation of heating, piping, and air conditioning systems.

WILL THE vast wartime industries, spread from coast to coast and from north to south, some with a single building of 50 acres of floor area, close their doors when the war ends? Will spiders spin their webs over closed valves, in a quiet broken only by the fall of dampened insulation? The writer thinks not, and that postwar production plans will become rapidly implemented in the same short space of time that conversion was made to war.

So-called "quarantine groups" of engineering specialists, but recently engaged in secret war work, are developing throughout industry as the idea of postwar planning spreads. One air conditioning manufacturer, for example, has a postwar plan group whose instructions forbid mixing with others of the organization. On every hand the itch is there for planning things, by national fortune telling if you will, but fortune telling by engineering calculations.

The future of air conditioning looms bright in such planning, even though at present the use of "Freon" for comfort air conditioning has been very much limited; or, as one organization puts it by notice in their store at Washington, "Air conditioning here no more, our 'Freon' has gone to war." New materials and processes make air conditioning mandatory where the material or process as formerly used did not require it; in others, the precision requirements of war introduced its use and subsequent operation disclosed advantages hitherto unknown—to the end that air conditioning becomes a necessity to such processes regardless of the war.

Many camps and war industries have been located in hotter climates than the soldiers and workers were accustomed to, and as a consequence they soon realized what it was to be without air conditioning. In other war plants, air conditioning is used at least in part of the plant, so that war workers in great numbers have become accustomed to viewing air conditioning as a necessity, and its lack as an exception to the rule. Labor will demand its wider use, even as it now does in the case of ventilation. The vast number of workers per plant, and the wider use of women employees, have created hospital, first aid, and personnel departments with doctors and nurses who stress the need for proper indoor atmospheric conditions.

Transportation via plane to hitherto unfamiliar hot spots of the globe will be rapid and frequent, and the traveller accustomed to air conditioning will also serve as an introduction to its use; in fact, the great part which this nation will have abroad in reconstruction cannot help but to introduce air conditioning.

Aside from the impetus given to air conditioning by the war, there will be the great pent-up demand for such equipment where none was allowed for the duration and for those places from which it was removed for relocation in war industries. It is probably too costly to return such equipment to its original location, and the depleted systems will no doubt be best served by more modern and improved equipment as well as by alteration to the systems themselves to bring them up-to-date.

The condition in which we will find heating, piping, and air conditioning equipment after the war is not hard to visualize for those who have been building everything, in many cases with next to nothing and with but little labor and protracted deliveries. There will be many converging demands, some for replacement of wornout things, some for the replacement of the noncritical things, and some for the much needed things which had to be foregone for the duration. Certain items not formerly allowed, such as boilers and other standby equipment, ventilation, coal and ash handling equipment, coal scales, controls, water treatment, return lines and pumps for domestic hot water circulation systems, and stokers in the smaller sizes will be required in many plants and buildings.

Temporary work must be made permanent; violations of codes or regulations on ventilation, plumbing, electric, sprinkler, fire protection, etc., must be removed; sprinklers and fire protection will go in where they were not allowed in wartime; fire hazards of boiler plants and of manufacturing plants will be eliminated by the removal of wood used for stairs, walkways, platforms, handrails, ladders, etc.; open wiring will be removed, makeshift ductwork*, thin sheet metal without galvanizing, and too-thin smoke breechings will be replaced; while second hand equipment and materials will in large part be replaced, such as boilers, tanks, pipe and motors (especially so where

*One large automobile company builds its ducts out of old automobile fenders.

overloaded under wartime conditions).

So much will have worn out from the forcing of equipment beyond capacity; the 24 hr operation of wartime conditions; the lack of time, men, or material for maintenance; and the use of temporary and inexperienced help. Boilers in particular will be worn out, or will be retubed as time will then allow due to the addition of standby boilers or the discontinuance of day and night operation seven days a week, including holidays. The steel coils of many unit heaters, air heaters, radiators, and heat exchangers may have to be replaced.

Simple emergency heating and ventilating systems built with a view to the least weight of critical materials required, will be replaced or improved with a view to better operating economy and results. Conversions from street steam or coal to oil or gas as formerly used will be made in some cases and a few central plants which were abandoned may again be operated.

A final point is that with the stoppage of war no substantial stock shelf may exist other than one equipped with substitute materials. In such a case industry will go on building immediately with as much desirable material as it can obtain and defer insofar as possible all construction requiring substitute materials.

Great Expansion of Air Conditioning Applications Predicted After the War

PRESAGING "GREAT expansion in the application of air conditioning to office buildings, apartment houses, hotels, and hospitals," Dr. Willis H. Carrier, chairman, Carrier Corp., outlined recently future advances in air conditioning made possible by combinations of central station equipment and individual room units, in an address before the Toronto section of the American Society of Mechanical Engineers. Discussing the economic value of air conditioning, he said:

"It seems probable that in the postwar era, the proved value of air conditioning even in machine shops will lead to a greatly expanded application of air conditioning. Indeed, it would seem that this is almost a 'must' in plants that are designed for high production. Moreover, in all industries manufacturing or processing hygroscopic or moisture-sensitive materials, as in the textile industries for example, exacting control of humidity as well as temperature is obviously essential. It is in these latter industries that air conditioning has been applied successfully for many years.

"In the production of synthetic textiles, such as rayon, air conditioning with exacting humidity control is indispensable.

"In hosiery knitting mills, air conditioning with refrigeration to maintain uniform temperature as well as humidity conditions in the summer has been found to pay large dividends on the investment.

"In fact, it is not unusual to find air conditioning applications in industry which return the investment within 1 yr of operation, while in many other industries it is paying from 20 to 30 per cent on the investment. In general, air conditioning is indicated in an industry whenever it can show a rate of return, based on an increase in the quality or output of the product, equal to the percentage of profit in the industry.

"Indeed, in many cases, the intangible benefits in industry derived from improved working conditions alone may make a return that warrants the investment. It is conceivable, in the future, that even cotton mills will find it advantageous to employ refrigeration with summer air conditioning to improve output through better working conditions. Such conditioning not only increases the efficiency of the workers but attracts the most skilled employees and stabilizes employment."

Describing the transition of air conditioning from large spaces, such as theaters, to numerous small spaces, such as office buildings, Dr. Carrier said:

"A unique system of winter and summer temperature control is that employed in the Pentagon building in Washington. This installation, which was designed by Charles Leopold, consulting engineer, probably represents the largest single air conditioning plant in the world. It requires 13,000 tons of refrigeration. In this installation, heat is provided by a forced circulation system of warm water which is available at any one of the 9000 units throughout the entire year. Each unit has a self-contained thermostatic control valve, operating on the water supply to the unit. This provides for control of room temperature in either winter or summer. Economy in refrigeration, when the weather permits, may be effected by bypassing a portion of the return air at the central station air conditioning apparatus. The use of heat to counteract refrigeration effect in summer is used only to the extent of necessary modulation required for different rooms and represents only a relatively small proportion of the total refrigeration load. This is a very simple and positive way of maintaining uniform ventilation and at the same time securing a simple automatic control."

The air conditioning installation for the Pentagon building in Washington requires 13,000 tons of refrigeration capacity. Heat is provided by a forced circulation system of warm water which is available at any one of the 9000 units throughout the entire year

"OPEN for DISCUSSION"

What 500 Installations Have Revealed About Radiant Heat

THE EDITOR—

I have read with great interest the article on radiant heating, by Charles A. Hawk, Jr., published in the January HPAC. Although I thoroughly agree with Mr. Hawk that there is nothing intricate either in the methods of calculating or installing radiant heating systems, I cannot agree entirely with some of the statements he made.

1) *Venting of Pipe Coils*—Pipe coils on radiant heating systems, when employing hot water as the heating medium, should definitely be vented. Although actual experience has shown that many unvented systems will work satisfactorily, there is never any assurance of this since it depends so much on the type of workmanship by the installing mechanic, and this, we will all agree, is quite variable. Naturally, it is not necessary to install a vent on each and every pipe coil, as in most cases one common vent to which all coils are piped is quite easily installed, but the pipe coils on hot water radiant heating systems should be vented if only for reason of safety, because the cost for correcting any air pockets after the floors are finished is quite expensive.

2) *Floor Covering*—My experience has shown that there are a few of the commonly used floor coverings which are objectionable for use in connection with radiant heating systems using floor coils. In particular, rubber tile floor covering can create difficulty due to odors and disintegration.

3) *Controls*—I cannot agree at all with Mr. Hawk in his statement regarding controls. True, the controls, as used on an ordinary radiator job, will serve fairly well to some extent on radiant heating jobs. However, I believe that the occupant of a radiant heated space expects and needs better control than is commonly used on radiator and warm air jobs. My experience has shown that:

a) Constant heat at the right temperature in accordance with outside temperature must be supplied to the radiant heating coils. This is particularly true in sections of the country where wide outside temperature fluctuations occur.

b) It is quite possible, from my own observation, that on a clear, sunshiny day, the outside temperature will drop 30 to 40 deg, while the sun itself has still its effect on a building well insulated and with large glass areas. The circulator is stopped from the room temperature effect on the room thermostat. Then suddenly the sun will lose its effect. In this short interim of time the room temperature may drop only ½ deg or less (not enough to start the circulator). However, the floor surface temperature in some test installations dropped 2 to 3 deg. This resulted in a considerable lag of time before comfortable conditions were again obtained. This difficulty can definitely be overcome by a control supplying heat constantly in accordance with outside conditions. In addition such a control will put a more even load on the source of heat.

c) The circulator should not be operated from an ordinary room thermostat, but rather by a radiant heat comfortstat. After all, on a radiant heating job we are not concerned with the actual air temperature, so why control the heat supply according to room temperature?

On single zone jobs this radiant heat comfortstat should preferably be wired to the control mentioned under (b) and employed to reduce the temperature of the heat supply below the temperature required according to outside temperatures. Thus, the advantages of constant circulation can be maintained.—E. M. MITTENDORFF, vice-president and general manager, Sarcotherm Controls, Inc.

Prominent Contractor Sees Big Postwar Part for Radiant Heat

THE EDITOR—

The discussion entitled Prominent Contractor Sees Big Postwar Part for Radiant Heat, by H. M. Hart, published in the February HPAC, was very interesting. From where we sit we find it a very easy matter to agree with the headline of Mr. Hart's article, but actual experience seems to be somewhat at variance with his conclusion that the ceiling type panel will become first choice.

Perhaps 95 per cent of all radiant heating installations in this country today are of the floor type, and this figure seems to be increasing steadily. Most designers seem to be tending away from the ceiling type installation, except for occasional unusual conditions, if for no other reason than that it is usually less expensive to install the floor type system. There are other considerations involved, but in order to keep the discussion orderly, suppose we refer to Mr. Hart's article point by point.

1) Perhaps one of the greatest stimulants for radiant heating has been the building designer's desire to place the lower surface of his structure directly on the ground. In the past such construction has

presented the obstacle of a cold floor, which has been exceedingly difficult to lick in climates where winters are at all severe. By the use of floor type radiant heating this obstacle has been easily overcome and more and more planning is being done along this line.

This still leaves standing Mr. Hart's objection of corrosion. As a remedy, two things should be done. First, restrict the presence of moisture as much as possible by using a crushed stone or gravel fill and, if appreciable moisture is to be expected, supplement with a waterproofing element. Second, use only piping materials which have a proved, longtime performance record against corrosion from ground moisture. There has yet to come to our attention any record of failure from corrosion in many hundreds of wrought iron floor type systems which go back over a number of years.

2) Heat loss into the ground is a difficult point to pin down, but continuing research by a number of different parties seems to indicate that it is a very small consideration. Furthermore, present calculation practice on the part of most engineers places this loss at a figure somewhere between 10 and 30 per cent of the total of other losses in the structure. In a room heated by ceiling coils or by any other conventional heating system, loss into the ground has to be taken into consideration and this normally results in a figure of approximately the same magnitude as those given above.

3) Different types of floor coverings have no measurable effect on heat input of floor systems. They affect only the operating level of the system and this introduces inefficiency only in the shape of losses at the boiler. The temperature drop from supply to return is the same, regardless of the floor covering. Floor systems have been used under all of the common floor coverings with apparently identical results. It is usually not necessary to know in advance what type of floor covering is likely to be involved because a well designed system will normally embody from 50 to 100 deg leeway in boiler operation which can be used to compensate for a variation in floor coverings. Balance from room to room is obtained simply by means of a small balancing valve in each element.

4) Upward heat loss from ceiling panels is usually just as great if not greater than downward loss from floor panels. Actually, for most construction this point becomes largely a toss-up.

As to exterior corrosion of the heating surface, it so happens that one of the few systems we have ever heard of which failed from corrosion was a ceiling installation. Consequently, it cannot be blithely said that exterior corrosion is not a factor in any radiant heating system.

5) Calculation of heat flow from any panel, be it floor, wall or ceiling, is six-of-one and a half-a-dozen of the other. As a matter of fact, basing the statement on some of Dr. Giesecke's work, reported in Heating, Piping & Air Conditioning for August 1940, the convection output from a floor panel is twice as much as that of a ceiling panel with equal panel and air temperatures.

6) From all practical observations it would seem that no conceivable amount of furniture has any particular effect on the performance of floor type radiant heating systems. A number of churches making use of floor type systems seem to perform identically with other structures, and it is hard to imagine a floor surface more completely masked than the floor of a church with solid, stationary wooden pew seats over perhaps 50 per cent of the floor area. Certainly as far as damage to furniture is concerned, temperatures involved are so low and so close to room air temperatures that there is no apparent reason for expecting any damage. Furniture in rooms heated by floor panel systems which have aged several years shows absolutely no signs of undue depreciation.

As to the question of sensible comfort obtained with either floor or ceiling type systems, there are a number of tests going on at the present time which may throw some light on the problem. However, observation of a great many systems of both types does not seem to produce any marked differential to choose from insofar as comfort alone is concerned. Thus, the economical factors which seem to favor the floor type system will probably remain as the governing influence.

The information that the Heating, Piping and Air Conditioning Contractors National Association is now preparing a simplified data book is good news indeed.—C. A. HAWK, JR., engineering service dept., A. M. Byers Co.

The Drying of Foods

THE EDITOR—

I have read with great interest the article on The Drying of Foods, by W. R. Marshall, Jr., which appeared in the November HPAC. While Mr. Marshall's statements about the need for rational methods of dehydrater design meet with my hearty approval, a number of the procedures used in his calculation seem to me open to serious question.

In the first place, the selection of conditions for the sample calculation is such that some important characteristics of the dryer are overlooked. In particular, it is neither practicable nor desirable to operate a cabinet dryer for commercial use at constant dry and wet bulb temperatures throughout the cycle. It is not practicable because it would be uneconomic to install so large a heater as that would call for, knowing that a heater only a small fraction as large would be ample during most of the run.

Mr. Marshall based his calculations upon a single assumed drying curve,* representing constant-temperature conditions. If the practical situation of a varying temperature is to be faced, it is obviously necessary to have either a whole group of such curves, each corresponding in some part to a particular segment of the actual drying cycle, or, more usefully, a general analytical or graphical expression which allows an unlimited

*While the precise drying curve used has no bearing on the validity of the method of calculation, it should be noted that Mr. Marshall's Fig. 2 fails by almost 20 per cent to be an accurate reproduction of my data, after allowance is made for the 50 per cent change in the time coordinate.

variety of such choices to be made. A typical example of general graphical expression has recently been published by A. H. Brown and P. W. Kilpatrick, of this laboratory, under the title, The Drying Characteristics of Vegetables; Riced White Potatoes, Trans. ASME, *65* (5), 837-42, November 1943. Similar general correlations are now available for several other vegetables, and additional ones are in process of publication. When this complete information about drying rates is used as the basis for dehydrater design, the solution becomes much more realistic, and may be extended to include several important factors which are beyond the reach of the method proposed by Mr. Marshall.

Aside from the question of adequacy of experimental foundation, the procedure described in the article appears to be unnecessarily cumbersome and to contain the possibility of seriously faulty estimates of some characteristics. For example, the manner in which "factors of safety" are introduced actually leads to optimistic estimates of heat requirement, not to conservative ones.

Mr. Marshall's angle of approach to the problem seems mistaken in two respects. One is his use of "output per unit of time" as the basic datum; while that would be entirely appropriate for the design of any continuous type of dehydrater, it is decidely inappropriate as a basis for the design of a batch dehydrater. Again, the choice of an "average temperature drop across the trays" has an illusory appearance of freedom. That quantity is really a dependent variable whose value is fixed when other essential choices have been made. Only a limited number of the variables which appear in the general dehydrater equation may be independent—the rest must be dependent; and we have been increasingly impressed with the importance of a judicious decision about the ones which are to be taken as independent.

We also believe that Mr. Marshall's insistence upon use of a "constant-rate period" is unnecessary and unfortunate—unnecessary because it does not simplify the calculation in any respect, and unfortunate both because it does violence to the experimental data and because it obscures some of the important operating characteristics of a cabinet dehydrater. In the experimental drying curve from which the example is drawn the drying rate (expressed in terms of pounds moisture evaporated/lb. b. d.-hour) falls from an initial value of 3.4 to 1.25 in the 1¼ hr taken by Mr. Marshall as a "constant-rate period." A change of that magnitude has important consequences in the operation of the dryer.

These criticisms are not constructive unless we propose an alternative method we think is better. Since a discussion of this sort is hardly an appropriate vehicle to carry such a proposal, we shall submit to you shortly an article in which we will describe the methods that have been used in this laboratory for making this kind of design calculation.

A minor arithmetical error has been noted in the calculation of capacity, bottom of the last column on p. 569 of Mr. Marshall's article. The factor 0.19 reduces the weight of output to a bone dry basis. Since the design was to be based upon a delivery of 50 lb per hr at 10 per cent moisture (dry basis) the output per hr per sq ft will be 10 per cent more than 0.0663, or 0.0729, and the total area and number of trays required will be reduced correspondingly.

Incidentally, I should like to propose the uniform use of a certain convention about "per cent moisture." Mr. Marshall has informed me in a private communication that in this article "10 per cent moisture" is assumed to be "dry basis"—that is, 10 lb of moisture per 100 lb bone-dry. Used in this manner, without specific identification, there is a good chance that the reader will assume "moist basis," for the laboratory moisture determinations are always reported that way, and government specifications for dehydrated foods mean that when they say "per cent moisture." The confusion would be eliminated if the term "per cent moisture" were reserved for the moist basis meaning (10 lb of moisture per 100 lb of moist product), and dry basis moisture were always used without reduction to percentage. Using Mr. Marshall's nomenclature, there would then be no doubt that "10 per cent moisture" means something different from "$w = 0.10$." Actually, it is no more convenient to say that a raw potato contains "425 per cent moisture, on the dry basis," than to say that it contains "4.25 lb of moisture per lb bone-dry."

Mr. Marshall's suggestion of an arrangement of the dehydrater which places the fan on the upstream side of the heater (first column, p. 572) is open to some question. Both this arrangement and its reverse have some characteristic disadvantages. When the fan is upstream a fin coil heater serves as a quite efficient "straightening" device which tends to equalize the uneven velocity distribution of air coming from the fan; but since the heater will be used at only a fraction of its capacity during most of the run, it will usually have a hot side and a cool side, and the air stream will be badly stratified in temperature. We usually regard an uneven velocity distribution as being less difficult to overcome than temperature stratification in a well-straightened air stream.—W. B. VAN ARSDEL, chief, engineering and development division, western regional research laboratory, U. S. Department of Agriculture.

HPAC's readers and editors will welcome your comment on articles or parts of articles published in these pages, and on other topics of interest to those concerned with design, installation, operation, and maintenance of heating, piping, and air conditioning systems in industrial plants, commercial, institutional, and public buildings . . . Address The Editor, Heating, Piping & Air Conditioning, 6 North Michigan Avenue, Chicago 2, Illinois.

WPB...OPA PAW...Etc.

Coal Stokers for Large Apartment Buildings Available

Members of the stoker manufacturers industrial advisory committee have announced that coal stokers of the type required to heat large apartment buildings are available in reasonable supply, the WPB reported February 14.

At the same time, the members emphasized that they had concentrated more on repairing existing stokers which increased the demand for repair parts. The manufacturers hoped they would not only be able to meet this demand, but that they also might replace wornout stokers during the current year.

A representative from the Solid Fuels Administration told members that although the supply of bituminous coal in sizes required for stokers was adequate, it was impossible under present conditions to prevent local shortages.

"Freon" Production Facilities To Be Completed on Time

Definite assurances that construction of new "Freon" producing facilities would be completed on time have been given the general refrigeration and air conditioning industry advisory committee, the WPB announced February 11.

These new facilities, which will bring the monthly production of this refrigerant gas to 4,800,000 lb, are located at Deepwater, N. J., and East Chicago, Ind. The Deepwater factory is an addition to the present plant, which is now producing at the rate of 1,800,000 lb monthly. Completion of the new unit, originally scheduled to be in operation by February 1, has been delayed until April 1. It will add another million pounds per month to the supply. The East Chicago plant, which will go into production September 1, will increase the total monthly production another 2,000,000 lb. Assurances were also given to the committee that adequate stocks of raw materials would be available for the new producing facilities.

No Relaxation of Restrictions

Although production capacity will thus reach a fourfold increase over peacetime production, vastly increased demands for this refrigerant gas, to be used in essential air conditioning of war plants, ships, etc., will not permit relaxation of present restrictions on its use and purchase, WPB officials warned.

In response to queries by the committee, WPB officials stated that there were no programs now under consideration for easing restrictions on the manufacture of various prohibited items of air conditioning and refrigeration equipment such as display cases, beverage coolers, comfort cooling machinery, and other items.

Simplified Procedure for WPB Authorization for Construction

A simplified procedure for acquiring authorization for agricultural, commercial and industrial construction was announced last month by the WPB. The procedure for obtaining materials for authorized construction projects also was simplified.

The new procedure establishes a method of assigning a preference rating and allotment symbol F-6 to an approved construction project. Under the change, the symbol and rating may be used to purchase controlled materials and other construction materials without reference to calendar quarters, in amounts required to complete the project. The changes are in line with WPB policy to reduce paper work on the part of the applicants and expedite final action, but represent no relaxation of existing controls.

These objectives are obtained through the revision of WPB application form 617 and instructions, a new authorization form GA-1456 supplanting CMPL-224, and the coincidental issuance of direction 1 to controlled materials plan regulation 6, which makes the changes possible.

The direction provides for the assignment of an allotment symbol and preference rating on approved construction to obtain the controlled and noncontrolled materials needed to complete the project without reference to quantities or calendar quarters in which the materials must be ordered.

Heretofore, an applicant, in addition to being required to justify the need for his project, had to list all materials to complete the job. Under the new procedure, an applicant still justifies the essentiality of his project and lists certain scarce items of equipment, but is not required to enumerate specifically all construction materials needed.

With the exception of housing, direction 1 applies to practically all civilian construction.

Attention was called by WPB to the fact that the direction does not affect authorizations heretofore issued on CMPL-224 or orders of the P-19 series. However, any amendments to such authorizations will be issued on the new authorizations form.

In filing form 617 as revised, the applicant will be required to describe the type of construction in sufficient detail to indicate the size and general layout. If the application is approved, form GA-1456 will be issued to him granting (1) authorization to begin construction, (2) the right to use the allotment symbol F-6, and (3) the preference rating assigned to purchase construction materials other than controlled materials, and approved equipment necessary to complete the project.

Material control is obtained by the use of "construction limitations," which are included in the instructions to indicate in advance to the applicant the current prohibitions and restrictions on the use of critical materials. If certain of the prohibited items are required in the construction of a project, the applicant is given the opportunity of indicating and justifying the need for these materials on the original application form. If such requested exceptions to the construction limitations are approved, the exceptions will be noted in the authorization form GA-1456.

Natural Gas Deliveries in Midwest Curtailed by U-7 Directive

Sixty natural gas distributing companies in a six-state area are forbidden by a new directive of the Office of War Utilities to make deliveries from February 14 to March 31 to commercial or industrial customers who have adequate standby facilities capable of burning fuel other than natural or liquefied petroleum gas, the WPB reported February 9.

The companies affected (in Missouri, Michigan, Illinois, Indiana, Ohio, and Kentucky) draw supplies from the Panhandle Eastern Pipeline Co., which moves substantial quantities of natural gas eastward from Texas and Kansas. Curtailment of deliveries to these states will make larger quantities of gas available to the Appalachian area where a shortage of natural gas is threatening war production. Restrictions announced February 9 heretofore have applied only within the Appalachian area, defined as Virginia, West Virginia, Maryland, Ohio, Pennsylvania, New York, the District of Columbia, and northwestern Kentucky.

In addition to restricting deliveries to customers having stand-by facilities, the new directive (general directive 1-A under utilities order U-7) requires that in event of shortages that call for additional curtailments, preference in deliveries must be given those war and essential civilian users listed in the U-7 order.

L-42 Amendment Removes Many Radiator Valve and Trap Restrictions

Many simplification and standardization requirements have been eliminated in the manufacture of radiator supply valves, low pressure thermostatic radiator traps, combination float and thermostatic traps, and boiler return traps, the WPB reported last month. Because simplified models "have not proved satisfactory in all cases," it was considered essential to remove as many restrictions as possible.

The action was taken in an amendment to order L-42, schedule VIII whose title has been changed to read Radiator Supply Valves, Thermostatic, Float and Boiler Return Traps, instead of Vapor and Vacuum Heating Specialties.

The amendment schedule provides that any copper base alloy used in the production of bodies for radiator supply valves shall be made without the use of any primary copper or tin and shall be of no higher grade than a maximum of 86 per cent copper and 6 per cent tin.

No packless radiator supply valves may be produced with metallic bellows or diaphragms according to the amended schedule, but such valves may be made in any type or pattern; and there are no restrictions as to size. Previously, only one type, the spring packed radiator supply valve, was permitted for each manufacturer.

Former restrictions as to sizes, designs, patterns, and types of low pressure thermostatic radiator and drip traps, combination float and thermostatic traps, and boiler return traps have been removed except that the bodies of these items are still required to be made of cast iron.

The restrictions still in existence under the revised schedule do not apply to the production of articles or parts not available in the producer's inventory for use in ships, boats, or planes when required by the Army, Navy, Maritime Commission, War Shipping Administration, or Coast Guard, or for use in chemical plants, research laboratories, and hospitals. The previous schedule made an exception to the use of copper or copper base alloy in the manufacture of articles or parts for use on vessels other than pleasure craft and on aircraft where corrosive action made the use of other material impractical but it did not specifically list those government agencies that could apply the exemption.

New Production Scheduling Procedures in Amended M-293

Scheduling procedures designed to bring about greater utilization of available productive facilities have been adopted by the WPB, J. A. Krug, program vice-chairman, and L. R. Boulware, operations vice-chairman, announced February 10.

During the last year, scheduling controls have been implemented by WPB under rigid rules, requiring manufacturers to file detailed order sequence reports with the various WPB industry divisions. As a result of this experience, it has now become possible to center controls in the hands of the manufacturers themselves.

Major purpose of the shift in scheduling controls is to center responsibility for meeting delivery requirements of specific components and parts in the hands of manufacturers as far as possible. Items which are affected by the changed procedure are those which are common to more than one—in some instances, many—war production programs.

The new scheduling procedures are spelled out in general scheduling order M-293, as amended February 10. This order (1) modifies procedures in connection with class X products, (2) includes specific provisions with respect to undesignated products, and (3) eliminates the class Z product designation and rules which have governed scheduling of them.

Definition of Brass Mill Product Given in Amended CMP-4

The definition of an item of brass mill product, used in rules governing warehouse deliveries of such items, has been modified to indicate that difference in temper will differentiate one item of copper and brass sheet from another, the WPB announced last month. Formerly, both length and temper would differentiate one item of such sheet from another.

The definition of items, contained in CMP regulation No. 4, as amended February 10, dealing with sales of controlled materials by warehouses, governs amounts of specific controlled materials forms and shapes of brass mill products that can be delivered by a warehouse. Limitations on deliveries are on an item basis, and as a result, the definition has a direct bearing on deliverable amounts.

Commercial and Domestic Electric Fan Situation Summarized

The WPB reported January 31 that members of the domestic and commercial electric fan industry advisory committee have emphasized that no production of electric fans for retail sale to civilians can be resumed, and production of fans for essential industrial and hospital purposes cannot be increased enough to meet the demand under present restrictions.

Committee members said that the industry cannot be reopened for civilian production without detriment to the war work in which the industry is engaged. They recommended, however, that limitations on materials needed by the industry be relaxed sufficiently to permit the carrying out of a war emergency program for the production of 100,000 fans this year to fill military and export orders and as much of the essential industrial and hospital demand as possible.

WPB Catalogs 30,690 Surplus Steel Valves

A catalog of 30,690 new surplus steel valves of various sizes and types has been published for the use of war contractors or others, the WPB announced last month.

The list was published by the surplus program section of the redistribution division in cooperation with the Metals Reserve Co. It indicates the type of valves, catalog specifications, manufacturers' names, and state location. It will be available for inspection by steel valve users in WPB's regional or district offices. Claimant agencies will also have copies available.

M-9-c-4 Amendment Frees Some Copper Pipe and Tubing

Frozen inventories of copper and copper base alloy pipe, tubing, and fittings in the hands of utilities were freed January 24, the WPB announced recently, for use in underground gas and water supply and distribution installations outside buildings.

This action was effected by amending supplementary conservation order M-9-c-4 and was made possible by the better supply-demand situation of copper ingot, which makes purchase of completely fabricated material for remelt no longer necessary. In the past, finished products were remelted to furnish ingots for items more needed in the war effort.

Amendment to CMP-1 Affects Orders for Copper and Aluminum

The portion of schedule III of controlled materials plan regulation No. 1, dealing with the time for placement of authorized controlled material orders for copper and aluminum was inadvertently omitted from the revision on February 2 of that regulation, the WPB has announced.

Schedule III indicates the number of days in advance of the first day of the month in which delivery of controlled materials is required that orders must be placed with producers. As a result of the omission, it has been necessary to insert the portion of the schedule dealing with copper and aluminum in the regulation by amendment No. 1. There have been no changes in the number of days indicated in each case.

Antifriction Bearing Deliveries Limited by M-293 Provision

The WPB has ordered that users of antifriction bearings may not accept deliveries in excess of specified amounts during any one month of the second and third calendar quarters of 1944 without specific approval, it was announced February 9.

This action (direction No. 1 to table 12 of order M-293) was taken in a move "to relate the actual needs for such bearings to the supply, and to assure that statements of delivery requirements are realistic."

Recent Amendments to Fuel Oil Ration Order RO-11

An index to amendments Nos. 1 *to* 50 *to the fuel oil rationing order* (*RO*-11) *appeared on pp.* 171-172 *of the April* 1943 *HPAC. Amendments* 51-60 *were covered on p.* 233, *May; amendments* 61-65 *on p.* 52, *front section, June; amendments* 66-71 *on pp.* 411-412, *August; amendments* 72-73 *on p.* 466, *September; amendments* 74-78 *on p.* 537, *October; amendments* 79-82 *on pp.* 174-175, *back section, November; amendments* 83-88 *on p.* 661, *December; amendments* 89-92 *on p.* 34, *January* 1944; *and amendment* 93 *on p.* 92, *February.*

Amendment 94, effective February 17, revises the record keeping provisions of the fuel oil rationing regulations providing for stricter control of sales of oil.

The following actions were taken:

1) Fuel oil dealers and primary suppliers are now to keep a record for at least two years of all their sales to other members of the trade.

This will facilitate the checking of sellers' records to learn whether their sales were in accordance with the rationing regulations. Previously, only the fuel oil purchaser, who was given an invoice or delivery ticket by the seller after the delivery was made, was required to keep this record.

2) OPA also provides now that, when oil is sold within the trade, a record must be kept by both the buyer and the seller showing:

a) The name and address of the buyer and seller;

b) The date, amount and place where the fuel oil was delivered;

c) The date and gallonage value of the ration currency surrendered;

d) Whether the ration currency was surrendered before, at the time of, or after the actual delivery of the oil was made.

According to the present regulations, dealers may arrange with the persons selling them oil to "pay for" oil deliveries with ration currency 15 days before or after the actual delivery is made.

3) This amendment also contains provisions regarding keeping of similar records by large fuel oil consumers and industrial users who have ration bank accounts. Their records are now to show the dates of actual delivery of the oil and surrender of ration checks.

These large consumers when receiving deliveries of 2000 gal of oil or more at one time have been allowed, under the present regulations, to give up the required ration checks, at the option of the seller within 15 days before or after the time of delivery.

When a ration check is issued by one of these large consumers in advance of the actual delivery, the seller is now also required to keep a record showing the date the check was received, its gallonage value, and the fact that it was issued in advance of the oil delivery. In addition, the seller is required to note on the record the date and amount of each delivery made against that check, immediately following the delivery.

Amendment 95, effective February 19, amends section 1394.5458 (a) by substituting for the phrase "in exchange for coupons of the series which will next become valid", the phrase "in exchange for coupons which have not yet become valid".

Other Government Actions Announced Last Month

WELDING ELECTRODES FREED: WPB announced revocation of limitation order L-318, which had set standards for manufacture of all spot welding electrodes.

CAST IRON PIPE RULE CHANGED: WPB announced that cast iron soil pipe and cast iron soil pipe fittings have been freed from all restrictions formerly imposed by general preference order M-21, by amendment of M-21.

HEATING TANKS CONTROL CHANGED: Sale of plumbing and heating tanks to consumers for replacement purposes no longer requires A-10 or better rating, WPB announced. Distribution restrictions of order L-199 have been removed in order to place all control over distribution under order L-79, the general plumbing and heating equipment distribution order which was revised on January 15.

CONSTRUCTION RESTRICTIONS TO STAND: WPB announced that tightness of lumber situation precludes any possibility of relaxing present restrictions on construction for civilian purposes.

CONSTRUCTION CONTROL SIMPLIFIED: Simplified procedure (WPB order P-55-C) eliminating filing of detailed list of materials (WPB form 2897) for privately financed housing construction and permitting use of additional materials to conserve lumber and fuel was announced jointly by WPB and National Housing Agency.

REPAIR RATING ORDER CLARIFIED. WPB announced that it has clarified meaning of several provisions of preference rating order P-68, relating to maintenance, repair, and operating supplies for producers of iron and steel.

CERTAIN CONSTRUCTION PROCEDURE REVISED. Procedure for obtaining authorization to begin construction of hotels, apartment buildings, and office and loft buildings has been revised as result of general simplification of procedure for acquiring authorization for all agricultural, commercial, and industrial construction which became effective February 15, WPB announced.

REPAIR RULE EXPLAINED. Repairmen may use only up to $25 worth of material purchased under procedures contained in CMPR 9A for installing any unit of cooking, plumbing, heating or used air conditioning or refrigeration equipment, WPB controlled materials plan division announced.

FUEL OIL ORDER REVISED. Revised ration order 11 covering original order and all 95 amendments issued to date, was released by OPA February 28, and became effective on that date.

FUEL OIL PRIORITIES SET. First call on available fuel oil supplies in country was given to six federal war agencies by PAW. Available supplies of fuel oil throughout country must first be used to meet requirements of Army, Navy, Coast Guard, War Shipping Administration, Maritime Commission, and Foreign Economic Administration.

Quartermaster Corps Develops Many Heating Units for Army's Use

Among the types of heaters and ranges developed by the Army quartermaster corps for use by troops there is a midget model, weighing less than 1½ lb, made especially for soldiers alone or in small groups. Then there is a new immersion type water heater which is placed directly in the can of clear water used for rinsing mess kits. It heats the water more quickly than models placed under the can and consumes less fuel. It operates on gasoline, fuel oil, or kerosene and gives off no visible flame. It is contained inside its own can for moving and saves 50 per cent in weight and space.

Insofar as heating tents or temporary quarters is concerned, the quartermaster corps has developed an adapter unit which is used in conjunction with the regular Army tent stove. It permits the burning of gasoline, fuel oil, or crankcase drainings, and tests have disclosed that it provides heat comparable with that from the maximum amount of coal the stove will hold.

WHAT MAKES A MOTOR RUN?

The electric motor is the most universally applied piece of electric apparatus—no plant or building is without one. Here is a simple, concise explanation of what makes a motor work, presented with the thought that those who design, install, operate, and maintain systems of which motors are a part will benefit by such a discussion of fundamentals . . . The author, a motor authority, is R. H. Rogers, of the industrial engineering division, General Electric Co.

AN ELECTRIC motor consists of two members, one that is stationary and one that can revolve (Fig. 1). Each has electric conductors in or around parts made of thin steel laminations, together with such supports and fastenings as are necessary to make them usable.

When electric energy is supplied to the conductors, the member that is free to turn revolves and delivers mechanical power through a belt, chain, gear, or coupling to the driven machine.

Fundamental Principle

If a magnet that is free to turn is brought near a fixed magnet, the free magnet will turn to line itself up with the fixed one with its north and south ends opposite the south and north ends of the fixed magnet (Fig. 2.) This is a fundamental principle of magnetism — *unlike poles attract; like poles repel.*

When the free magnet turned, it did so vigorously, twisting the suspending thread. *It did mechanical work.*

Rotation Established

Suppose one bar of iron is laid across another and a magnetized needle is suspended by a thread over the crossing point. Since the iron pieces are not magnetized, the suspended magnet can point in any direction (Fig. 3.)

Now, if by some means the bars are magnetized and demagnetized so that given poles appear in rotation, the free magnet turns to follow the successive locations of north and south poles. The free magnet is thus made to revolve continuously and we have a miniature motor (Fig. 4.)

Electromagnets

We have means for rapidly magnetizing and demagnetizing iron and reversing its north-south characteristic. A coil of wire around iron will make a magnet of it when electric current is passed through the wire. If the iron is of the proper kind it will lose its magnetism almost instantly when the current is shut off. If the current is started again in the reverse direction the iron will be magnetized with N-S where S-N was before. The polarity is said to be reversed. (Fig. 5.)

This is an electromagnet—much stronger than a permanent magnet and subject to control, i.e., on-off-reverse with great rapidity.

Push and Pull

To go back to the motor—both the stationary member and the revolving member are largely electromagnets since the windings through which electric currents flow are wound around sections of iron. These sections of one member will be made alive-dead-alive again with polarity reversed in a regularly repeated cycle. The sections of the other member will stay alive with polarity unchanged.

The reaction—push-pull—between magnets makes it possible to hold either member still and to let the other member revolve. The effort that makes a motor shaft revolve one way is trying equally hard to revolve the stationary part the other way. Whichever member is free to turn will turn (Fig. 6.)

Motors are built with the constant polarity member (i.e., magnetized needle, in the example) either rotating or standing still and conversely with the reversing polarity member standing still or ro-

SEE OPPOSITE PAGE

Fig. 1—An electric motor has a stationary member and a revolving member. It converts electric energy into mechanical power

Fig. 2—The north pole of the free magnet is attracted to the south pole of the fixed magnet

Fig. 3—A magnetized needle suspended by a thread with swivel has no reason for revolving

Fig. 4—This series shows how the needle revolves as it follows unlike poles in rotation

Fig. 5—Electromagnets are strong and controllable

Fig. 6—The motor frame can be stationary with the shaft revolving or the shaft can be stationary with the frame revolving

Fig. 7—The men on the inner circle are being kicked and pulled along. The men on the outside circle reverse their attitutes as the inner men pass by

Fig. 8—The poles of the revolving member are kicked and pulled by the poles of the stationary member. Watch the arrowed *N*

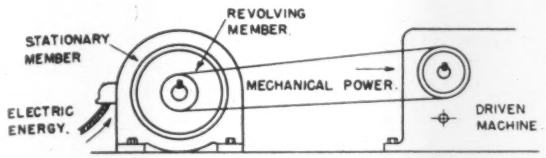
Fig. 9—The arrowed *N* has moved to a new space but it again has an *N* behind it and an *S* ahead

Fig. 10—A magnet is an alternating current circuit

Fig. 11—In a direct current motor, just as a moving north pole comes to a fixed south pole, its coil terminals (commutator bars) contact brushes of opposite polarity and the moving pole becomes a south pole

Fig. 12—The moving south pole is now trying to get away from the fixed south pole

Fig. 13—In an alternating current system, voltage (pressure) and current (flow) rise from zero to a peak and then decay to zero twice in a cycle—once each way



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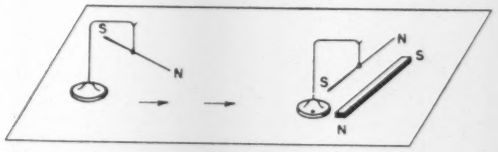

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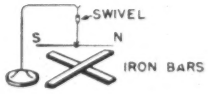

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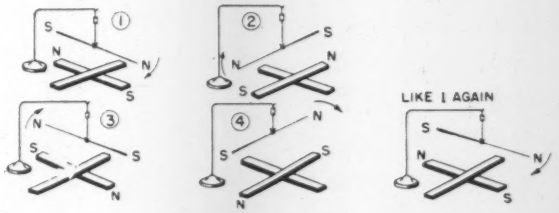

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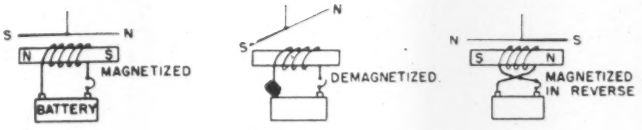

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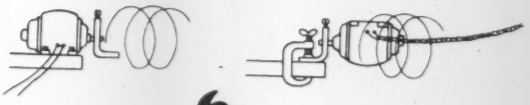

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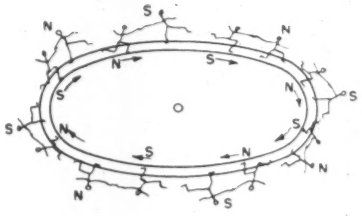

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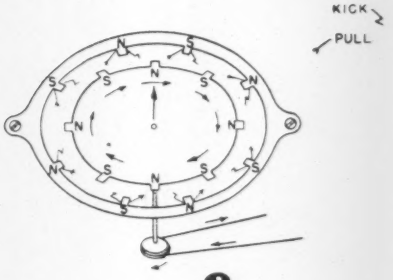

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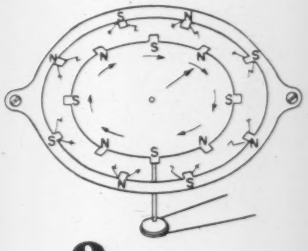

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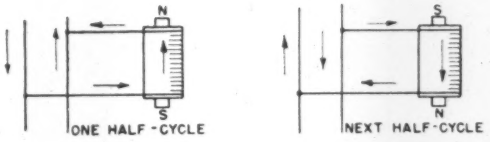

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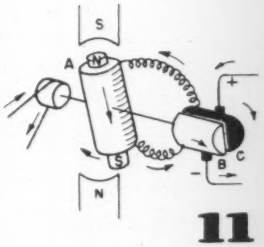

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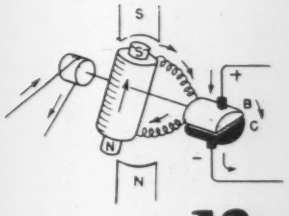

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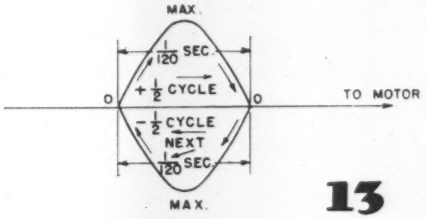

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tating. Circumstances of design determine which way it will be.

The poles on the rotating member are kicked along by the poles behind and pulled along by the poles ahead (Fig. 7.) As soon as a pole "comes abreast" of the pole that is pulling it, polarity changes and a new set of kicks and pulls is established. The sum total of all the kicks and pulls on all the poles of the rotating member is the turning effort or torque of the motor.

There are strategic times at which to reverse polarities in each revolution (Figs. 8 and 9.)

How Poles Are Reversed

Reversals are effected with time precision in one of two ways. With alternating current, the alternations themselves reverse the polarity of a magnet with each reversal of current flow (Fig. 10.) The current and hence the poles in one member reverse 120 times per second when the electric system has a frequency of 60 cycles per second.

In direct current motors the reversals are caused by the revolving member itself through something like sequence valving action of the commutator and brushes.

By the time a pole on the rotating member has reached the point of greatest attraction (*A* in Fig. 11), its polarity is changed because its commutator bars (*B-C* in Fig. 11) (terminals of the coils) have passed to brushes of opposite sign (*B-C* in Fig. 12). That is, the bars that were in contact with plus and minus brushes are now in contact with minus and plus brushes and current through the magnetizing coil is reversed. What was a north pole in Fig. 11 is a south pole in Fig. 12.

Note, with direct current, one power line is plus and the other minus all the time, while with alternating current the lines change through plus-and-minus to minus-and-plus with great rapidity (Fig. 13.)

To recapitulate then, we may say that a motor runs because poles of one polarity are chasing after poles of the opposite polarity and are being pushed along by poles of the same polarity. But the moving poles never get to the attracting poles because that desirable point is always just ahead, because of the timely reversals of current in alternating current motors, or the equally timely action of the commutator in direct current motors.

Radiant Heating Used in C. & E. I. R.R. Shops Built Forty Years Ago

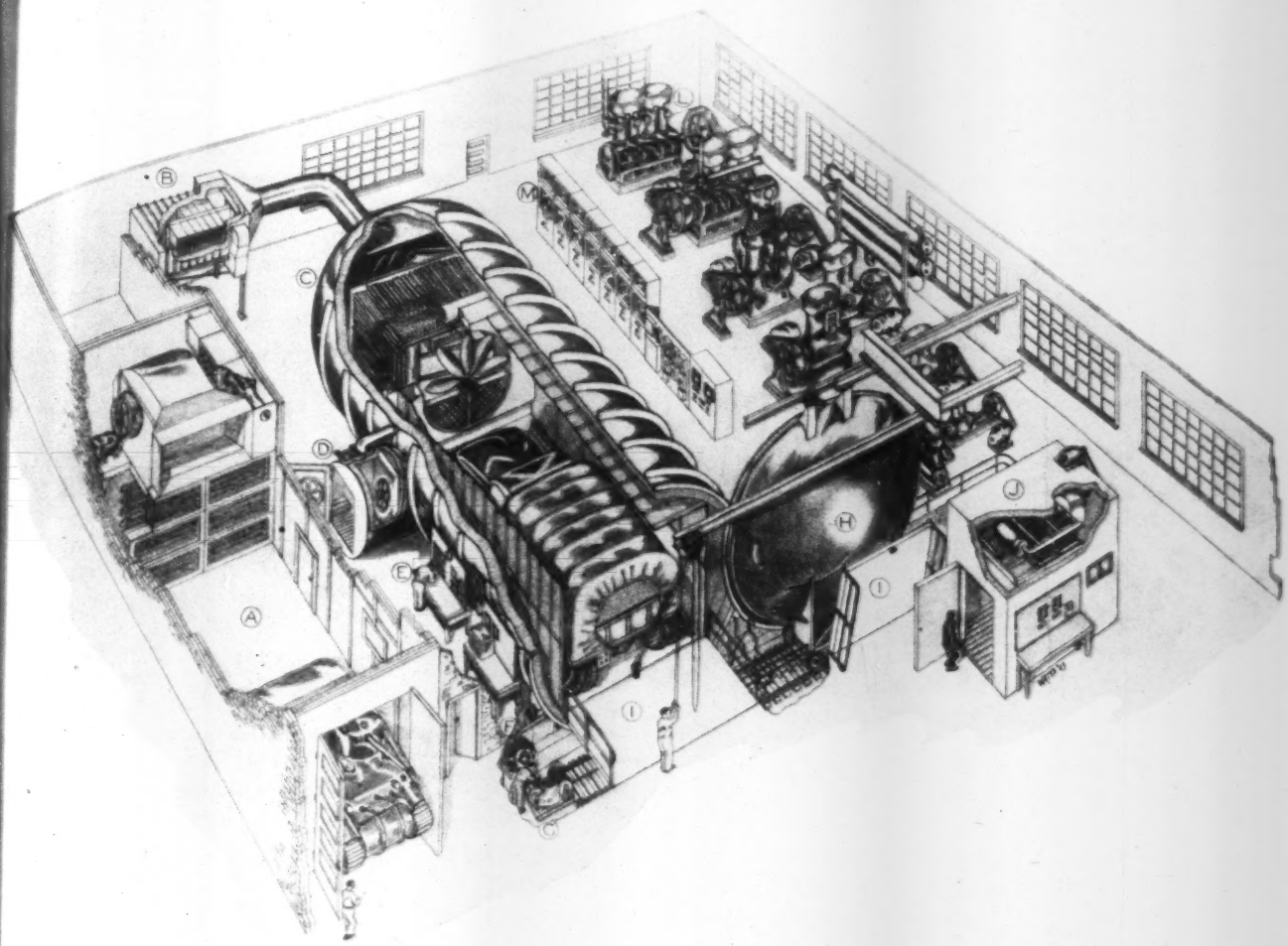
Irving Brooke Delves Into Files to Dig Up Data on an Early Installation

RADIANT HEATING was the subject under discussion at a recent meeting of heating and ventilating engineers, and during the course of the evening, Irving E. Brooke, consulting engineer, mentioned that this method had been used in the U. S. earlier than most people thought. He cited the Oaklawn shops of the Chicago & Eastern Illinois Railroad at Danville, Ill., which were described in the Railway Age of November 20, 1903, and the Master Mechanic of August 1904. The following paragraphs have been taken from a bulletin which Mr. Brooke dug up in his files:

"The heating system is considered a novel scheme as applied to the heating of open shops. The "duplex system" of vacuum steam heating is used throughout the shops, the warming of the air being accomplished by radiant heat, rather than by convection. For this purpose, the coils are placed near the top of the building rather than at the bottom, some of them being as much as 45 ft from the floor. The principle of the system is as follows: The heat from the overhead coils is absorbed by the solid substances of the floor and walls, which in turn become heat radiators and warm the air. The system is designed to maintain a temperature of 65 F within 6 ft of the floor. The fact that the floors, walls, and all solid substances are all at a comfortable temperature, slightly higher than that of the air, makes the shop comfortable without the necessity of maintaining the air at a higher temperature. Important claims of economy and efficiency in operation are made, together with the additional advantage due to the fact that the coils may be so located as to obstruct very little valuable space.

"A total of 42,000 linear ft of 1¼ in. pipe is installed, and it is calculated that 9000 lb per hr of steam will be required in extreme cold weather, but with each pipe under separate control only so many need be filled as weather conditions demand. Another feature peculiar to this method of heating is that there are no valves used in the construction except the service valve on the main steam and return pipe of each building. The blacksmith shop contains several steam hammers and the exhaust from them is introduced into the heating system by passing first through an oil separator and then to a large expansion tank, which reduces the blow of the exhaust. A connection is made between this tank and the main heating pipe by a regulating valve through which the steam passes to the heating system without disturbing the pressure."

It is understood that the particular radiant heating installation in these shops was revised a few years after its first going into service by the addition of a considerable additional amount of pipe coil surface, partly because of the comparatively large amounts of ventilation air required and the need for heating this air.



Army Weather Laboratory Simulates Tropic to Stratosphere Conditions

Terry Mitchell, of the Frick Co., describes a "weather" laboratory used by the Corps of Engineers, U. S. Army, for testing equipment under a wide range of atmospheric conditions. Temperatures are controlled from plus 150 to minus 70 F, relative humidities from 20 to 100 per cent, and air pressures from atmospheric to several pounds per square inch below atmospheric. There are gages for determining carbon dioxide and carbon monoxide, and automatic control for any set group of conditions. . . . In the drawing, "A" indicates the high temperature test room, "B" the conditioner for makeup air when testing engines, "C" a low temperature test room, "D" the decompression air lock, "E" the instrument chart and observation room, "F" the vacuum pump for simulation of various altitudes, "G" the winch for propelling the tunnel head truck, "H" the quick opening tunnel head, "I" the drawbridges, "J" the small low temperature test room, "L" the refrigerating machine room, and "M" the automatic control panel and switchboard.

REFRIGERATION AND air conditioning engineers have successfully tackled some pretty difficult jobs. It is safe to say, however, that not many of them have presented more problems, or were more intricate and comprehensive, than a weather laboratory recently built for the Army. This job comprises not just one testing room, but three. It not only provides temperatures as low as minus 70 F, but furnishes air heated all the way up to plus 150 deg. The humidity of the air ranges from saturation to only 20 per cent. For simulating conditions at high altitudes, as met by a plane flying in the stratosphere, the air pressure can be reduced 5 or 10 psi below atmospheric. The motion of the air is controlled by numerous fans, the largest of which handles 100,000 cfm. A separate conditioning system supplies pure makeup air, as required for engine tests. Gages indicate the amounts of carbon monoxide and carbon dioxide present in the chambers. All of these conditions in the three chambers are maintained by automatic controls, arranged to be set in steps.

The laboratory is made up of a large high temperature room, a

still larger low temperature tunnel with air pressure control, and a small low temperature test room.

The "hot" room has separate sets of coils for steam, water, and direct expansion ammonia. The main blower, which is of the squirrel cage type, circulates 60,000 cfm of air through the room and over the steam and cold water coils; water can be sprayed into the air to increase humidity. An auxiliary blower of 750 cfm is connected to the ammonia coils, which are connected in turn to one of the low temperature refrigerating systems, for dehumidification.

The main tunnel is an immense steel tube, 22 ft in diameter and over 48 ft long. The shell is of welded steel ½ in. thick, braced on the outside with 10 rings, which measure 1 in. to 10 in. These rings have a flat extension at the bottom and serve as supports for the tunnel; expansion and contraction are taken up by rollers under the feet. Inside the tunnel there are heavy layers of insulation, covered with a cement finish. A steel floor, two vertical side walls, and a ceiling of asbestos board enclose a square space in the center of the tunnel. The air from the big multiblade propeller fan is driven through this space and returns between the sides, floor, and ceiling and the outer shell.

The air passes over banks of finned coils at the rear end of the tunnel. The shaft of the 100,000 cfm fan shaft extends through the center of these coils to a motor on the outside of the tunnel. Above this motor is the inlet for the makeup air, which is conditioned in the equipment at "B".

An air lock at "D" serves as a "decompression" chamber when the tunnel is operated under a partial vacuum. To make the dished head tight against the end of the tunnel under such conditions, a circular, one-piece tube of rubber is inserted between the flanges of the joint. The head slides away from the tunnel on a special railway truck, operated by the winch at "G". After the head has been "opened," one of the draw bridges "I" is lowered to permit easy access to the tunnel.

Windows, with the multiple layers of glass kept dry with silica gel, are placed in the side of the tunnel near the instrument table at "E". A powerful suction blower removes air from the tunnel when desired. The conditions within the tunnel can be maintained in any of 12 steps. The automatic control devices are partly in the pipe lines and partly in the switchboard at "M". They operate through a combination of electricity and compressed air.

The small cold room has three stages of control. This room, of course, has its own coils, 500 cfm fan, and controls. It is insulated with 10 in. of rock cork, covered with an asbestos material. The small cold room has its own three stage refrigerating system, which includes a 7¾ in. by 5 in. machine and a 4 in. by 4 in., both running at 600 rpm with low suction pressures, and a 3 in. by 3 in. at 500 rpm for the third stage.

There are 10 ammonia compressors in all. The two largest machines each have four cylinders of size 15 in. diameter by 10 in. stroke. These discharge into a pair of 11½ by 8's, each with two cylinders, while two 7 in. by 7 in. machines handle the high pressure work. A 4 in. by 4 in. compressor is used for pumpout service. Two small ammonia condensers, each 16 in. diameter by 12 ft long, carry the whole load.

The main 12 in. ammonia suction line runs through a large low pressure receiver, equipped with a liquid return pump. There are two intercoolers, two purgers, two gas and liquid coolers, two float controls, 100 thermometer wells, starters, relays, and special valves by the dozens, 24 motors, thousands of feet of finned coils, traps, supports, nozzles, wiring, etc., etc. The system is charged with 5000 lb of ammonia.

RED CROSS NEEDS YOUR HELP NOW!

When bombs fall there is no time to send help halfway around the world. When a badly wounded fighting man needs a transfusion, it is too late to begin looking for a blood donor or find a nurse to care for him. When a lonely soldier learns of trouble at home, he needs help—immediately.

The American Red Cross provides that help wherever and whenever the need arises. A continuous procession of blood donors must be maintained, nurses must be recruited for the Army and Navy, trained Red Cross workers and supplies must be sent to camps, hospitals, and foreign theaters of operation the world over.

When a train crash leaves scores injured, when flood engulfs a town, when epidemic strikes, delay may cost lives. Red Cross disaster relief and medical supplies, held in readiness for such emergencies, plus trained workers to rescue and assist victims and help in their rehabilitation, will prevent delay and thus save many lives.

To fulfill its many obligations to the armed forces and our people, the American Red Cross needs *your* help. During 1944 it must supply some 5,000,000 blood donations. Each month 2500 nurses must be recruited for the Army and Navy. Red Cross field directors and other trained personnel must be stationed at military and naval posts and hospitals to help our fighting men and their families when personal trouble brews, a task in which the Red Cross chapter on the home front ably does its share.

At home the Red Cross must continue to maintain a state of alert. Disasters must be met as they occur. Nurse's aides and first aiders must be trained and other educational projects continued. Food parcels for distribution to prisoners of war must be packed, surgical dressings made, and the thousand and one details of administering a farflung, busy organization must be attended.

All activities of the American Red Cross are financed by voluntary gifts and contributions. During March, designated by President Roosevelt as Red Cross month, the American Red Cross must raise its 1944 war fund of unprecedented size to meet unprecedented needs. *Your* contribution will assure maintenance of all Red Cross services and thus indirectly help save many a life. *Let's give!*

Heating, Piping & Air Conditioning

AMERICAN SOCIETY of HEATING and VENTILATING ENGINEERS

Journal Section

Proceedings of the 50th Annual Meeting

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Hotel Pennsylvania, New York, N. Y.
January 30-31, February 1-2, 1944

THE 50TH Annual Meeting of the Society established a record by a total registration of 920, of which 540 were Society members, 258 guests and 122 ladies. Nineteen of the 23 Past Presidents were in attendance.

First Session—Monday, January 31, 9:30 A. M.

The first session was called to order by Pres. M. F. Blankin, who stated that the greetings of the Honorable F. H. LaGuardia, Mayor of the City of New York, would be presented at the get-together luncheon.

Congratulatory messages were presented from various organizations as follows:

Pres. Malcolm Pirnie, New York, N. Y., of the *American Society of Civil Engineers* congratulated the Society on having multiplied the comforts, advanced the health and improved the efficiency of the citizens of this country during the past half century. He stated that the efforts of the Society had contributed greatly toward the abolishment of overlord ideology from the earth and had directly aided the present war effort. He pledged the cooperation of the *ASCE* with the ASHVE in promoting the practice of the principles of the American way of life in the future relations of this country with other nations.

E. I. Williams, New York, N. Y., represented Raymond Ashton, president of the *American Institute of Architects*. He emphasized the common interests of the *AIA* and the Society, and mentioned that the first paper read at the first meeting of the *AIA* was on the subject of furnaces and heating. He expressed the hope that the future would bring greater cooperation and greater understanding between the two organizations, and extended greetings and congratulations.

H. H. Henline, New York, N. Y., secretary of the *American Institute of Electrical Engineers*, pointed out that the ASHVE was one of the first Societies to encourage intensive development in a specialized field, as it had assumed the objective of the advancement of the science of heating, ventilating and air conditioning. He congratulated the Society upon the outstanding contributions made through the stimulation of research and invention and the development of codes and standards.

J. F. Stone, New York, N. Y., vice-president of the *American Society of Refrigerating Engineers*, presented the congratulations from his Society and emphasized many common interests of the Society and the *ASRE*.

J. R. Townsend, New York, N. Y., vice-president of the *American Society for Testing Materials*, extended congratulations and referred to the relation of the *ASTM* to the ASHVE as a supplier of information on standard methods for testing materials and on standard specifications for materials. He called attention to the fact that he represented Pres. Dean Harvey of the executive committee of the *ASTM*, and expressed the hope that the work of the ASHVE would be more successful because of the assistance provided by the *ASTM*.

Dr. P. G. Agnew, New York, N. Y., secretary of the *American Standards Association*, brought greetings and congratulations. He expressed appreciation of the cooperation which the Society had given the *ASA*, which had just celebrated its own silver anniversary.

Lee P. Hynes, Camden, N. J., vice-president of the *Engineers Club of Philadelphia*, congratulated the Society on its 50th Anniversary and spoke of the value of the Philadelphia Chapter of the Society as one of the local Chapters of national societies participating in the Affiliated Council of Engineering Societies started by the Engineers Club.

G. P. Nachman, Cleveland, Ohio, president of the *Heating, Piping and Air Conditioning Contractors National Association*, brought greetings and referred to the close association of members of the two societies because of similar interests, and also expressed anticipation that the excellent cooperation between the societies would continue.

D. W. Atwater, New York, N. Y., past president of the *Illuminating Engineering Society*, represented Howard C. Sharp, its president, and expressed the thought that light and heat are invariably associated and provide two essentials for human comfort and that, therefore, the two societies which are interested in light and heat would always naturally have very close associations. He also stated that from observation of the operation of the ASHVE the *IES* was about to launch a program of research and that it also hoped to compile a handbook modeled upon the Heating, Ventilating, Air Conditioning Guide. He concluded with an expression of heartiest congratulations and best wishes.

R. E. Ferry, New York, N. Y., secretary of the *Institute of Boiler and Radiator Manufacturers*, congratulated the Society upon its contributions to comfort and health, as well as its contribution to the war effort. He pointed to the still larger task of providing in post war years the maximum in comfort and health for everyone. He stated that it was the desire of the *IBRM* to supplement the work of the Society by the preparation of installation manuals based upon research sponsored by his organization.

Major G. A. Sherron, Chicago, Ill., of the executive committee of the *National Association of Building Owners and Managers*, congratulated the Society upon its golden anniversary and stated that his Society was not unmindful of its debt to the ASHVE which had made skyscrapers possible by its contribution to the development of adequate heating equipment.

H. E. Barth, Detroit, Mich., representing the *National Association of Fan Manufacturers*, presented the best wishes of the association, and mentioned the value of the Society's research and

scientific development to the *NAFM*. He referred to the general acceptance which is accorded the Society's published data.

R. S. Dill, Washington, D. C., Chief, Heat Transfer Section, *National Bureau of Standards*, expressed the good wishes of the Bureau of Standards for another 50 years of progress such as had been made in the past. He emphasized the similarity of interest which the Bureau of Standards, the Department of Commerce, and the Society have in that their objectives are to discover truth and to publish it.

J. F. Collins, Jr., Pittsburgh, Pa., secretary of the *National District Heating Association*, presented congratulations and best wishes to the Society and referred to the benefit which the *NDHA* had received from the friendly and cooperative support of the officers and members of the Society.

W. E. E. Koepler, Bluefield, W. Va., vice-president of the *Smoke Prevention Association of America*, presented congratulations and spoke of the desire of the *SPAA* to establish a friendly relationship with the ASHVE. He spoke about the efforts which his association had made to establish a cordial relationship between his association and the coal industry, as well as with other substantial organizations interested in development of fuel burning equipment. Mr. Koepler paid tribute to the great value of the Society's research.

J. E. Axeman, Williamsport, Pa., represented Homer Addams, president of the *Steel Heating Boiler Institute*, and expressed congratulations and best wishes for the future.

J. E. Tobey, New York, N. Y., chairman of the Technical Advisory Committee of Bituminous Coal Research, Inc., conveyed greetings and referred to the desire of his organization to cooperate in every way with the Society. He stated that much progress remained to be made in the development of equipment for burning soft coal efficiently, particularly in small homes. In a five-year research program to be conducted by the BCR, the number one project is the improvement of residential equipment.

E. C. Webb, Cleveland, Ohio, extended the congratulations of the *Stoker Manufacturers Association*. He paid tribute to the value of the Guide and other ASHVE publications to the *SMA*.

Dean R. L. Sackett, New York, N. Y., past president of the *Society for Promotion of Engineering Education*, represented Pres. R. E. Doherty, in bringing the congratulations of the *SPEE*. He spoke of the beneficial influence of the ASHVE in raising the standards of instruction in engineering colleges, and mentioned the Society's research in physiological effects of air conditioning as a contribution to the advancement of civilization.

H. O. Loebell, New York, N. Y., represented the *American Gas Association* in expressing the warm admiration which the members of the *AGA* have for the members of the Society. He complimented the Society upon having steadfastly adhered to one objective, that of developing better engineering methods by which to serve the public. He pointed out that survival for 50 years as a voluntary organization proved that the Society must have been of real service to the industries and the public. He referred to the common interest of the *AGA* and the Society in the improvement of one of man's basic needs—namely, shelter.

President Blankin referred to communications which had been received from various organizations as follows: A message of congratulations from the Engineers Society of Western Pennsylvania; a resolution of congratulations from the *Insulation Board Institute;* a message of congratulations from the *American Physical Society* and the *American Institute of Physics*, in which reference was made to the accomplishments of the Society in fulfilling the dreams of Lord Kelvin with reference to the air conditioning of homes; and a cable which contained the following message from Richard Crittall, *President:*

> INSTITUTION OF HEATING AND VENTILATING ENGINEERS OF GREAT BRITAIN SEND HEARTY CONGRATULATIONS AND GOOD WISHES TO ALL MEMBERS OF THE AMERICAN SOCIETY ON COMPLETING FIFTY YEARS' ACTIVE WORK FOR FURTHERING THE WELLBEING OF THEIR FELLOWMEN.

President Blankin called upon Alfred J. Offner, *General Chairman* of Committee on Arrangements for the 50th Annual Meeting, who extended the welcome of New York Chapter to the assembled members and guests.

President Blankin then announced the appointment of the Resolutions Committee consisting of R. A. Folsom, San Francisco, *Chairman*, H. Berkley Hedges, Philadelphia, and William Glass, Winnipeg, Canada.

President Blankin then stated that due to the death of Reginald Pelham Bolton there were no living Honorary Members of the Society. He announced that the Council was unanimous in endorsing the petitions nominating Dr. Willis H. Carrier, Syracuse, N. Y., and Dr. Arno C. Fieldner, Washington, D. C., for election as Honorary Members of the Society. He briefly reviewed the distinguished careers of the candidates.

On motion of Alfred J. Offner, seconded by T. T. Tucker, Atlanta, it was unanimously voted that Dr. Willis H. Carrier be elected an Honorary Member of the Society.

On motion of Thornton Lewis, Washington, D. C., seconded by W. A. Russell, Kansas City, Mo., it was voted that Dr. Arno C. Fieldner be elected an Honorary Member of the Society.

President Blankin then submitted his report on the present conditions of the Society as follows:

Annual Report of President

The 50th Annual Meeting of the American Society of Heating and Ventilating Engineers marks an outstanding milestone in the life of a great, scientific organization.

In the midst of the greatest war of all time we are met here in New York these three days to celebrate our glorious history, consider the present, and prepare for the future.

Since our 49th Annual Meeting in Cincinnati, much has transpired that will provide for that future. Our financial position has improved. We have enlarged the scope of our research work and our technical activities. Our membership has been increased and is at a new all-time high. Our Chapters have been strengthened. We have added a new Chapter and are planning others. Now let me enlarge a little on some of these statements.

First—Our Financial Position: We recently changed our financial year so that it ended October 31. In order to get on this new basis it was necessary for last year to only cover the ten month period from January 1 to October 31 with our new year beginning November 1, 1943, extending to October 31, 1944.

For the first time within my knowledge, we have brought our Reserve Fund up to the requirements of the By-Laws and that is—$15.00 for each member. We now have in this fund $54,395.45 of which $52,241.82 is in Government Securities, and the balance in cash and savings funds. We have subscribed heavily to the various War Loans. In 1942 we purchased $54,000.00 worth at par value; in 1943 we purchased $18,000.00 worth at par value and $8000.00 worth of Canadian Fourth and Fifth Victory Loan Bonds. The par value of all our U. S. Government and Canadian Bonds totals $117,000.00.

The Finance Committee was quite pessimistic about our income this year due to resignations, members in the Service, and possible curtailment of advertising and sales of The Guide. However, with the influx of new members and increased advertising and Guide Sales, we were able to keep up the standards of services to our members and still able to show a slight excess of income in our Budget.

Second—Research and Technical Activities: As we started this year, we were without a Technical Secretary due to the resignation of John James, and as a carry-over from the preceding year we had no Director of the Laboratory due to the call of Lieut.-Comdr. F. C. Houghten by the Navy. After a thorough discussion it was decided that now was the time to enlarge the scope of our research work and technical activities. This was to be accomplished by the employing of a new Technical Secretary who would concentrate his work on The Guide, and Codes and Standards, not devoting half his time to the Research Committee as was previously done. We were fortunate in securing Carl H. Flink for this position, which he has filled in a very creditable manner. Methods of handling Codes and Standards have been set up under the direction of L. P. Saunders, Chairman of this Committee, and I am sure that this troublesome problem, in the future, will function quite smoothly and new Codes and Standards will be evolved as rapidly as they may be needed.

It was also considered advisable to create a new position that of the Director of Research. This was done by Council and after a very diligent search we were quite fortunate in finding an outstanding man, who brought great honor to the Society in filling this position. I refer to Cyril Tasker from the Ontario Research Foundation, Ontario, Canada who took over this office on October 1, 1943.

It was also brought to the attention of the Council that it was desirable to move the Laboratory from the Bureau of Mines in Pittsburgh, after 25 years of very pleasant association. We needed more room and the Bureau of Mines needed some of the space that we were occupying, so a Committee was appointed at the Fall meeting of the Council with instructions to investigate the various proposals and suggestions made to the Society regarding the re-location of its Research Laboratory; select a new location for the Laboratory and make any arrangements that were appro-

priate for the headquarters of the Society. This Committee consisted of C. M. Ashley, Chairman of the Research Committee; J. F. Collins, Jr., Chairman of the Finance Committee; E. N. McDonnell, a Member of the Executive Committee; and the President as Chairman.

After investigating 12 proposals from various Universities and Institutions, the Committee unanimously selected the former Western Reserve Historical Society Building located at the corner of Euclid Avenue and East 107th St., Cleveland, Ohio. Our new Research Laboratory Building which we will occupy for at least the next 2 years will require the entire building, not just a small portion of it. The building is adjacent to the campuses of both Case School of Applied Science and Western Reserve University.

The Committee has further recommended that for the present the headquarters of the Society be maintained at its present location in New York, but that a committee be immediately appointed by Council to further investigate the possibility of combining the Laboratory and headquarters in one building so that such a move can be made immediately after the war, or before, if possible. I am sure that with our greater facilities, our enlarged scope of activities and the extension of our cooperative work with Universities and Technical Schools, it will be possible to attract a whole lot more interest on the part of industry in the great research work we are doing, and make even more feasible the possibility of our combined Laboratory and headquarters building.

Third—Membership: I am quite pleased with the splendid increase in membership this year, in spite of predictions that we would suffer a still further loss in members. In 1942 we had a loss of 380 members due to cancellations, resignations, death, and the creation of Life Members. We took in only 217 new members which gave us a net loss of 163.

Starting the year we had a total of 3006 members which, compared with 3147 members as of January 1, 1940, indicated that we were going backwards, and a great Society like ours cannot afford to stand still on membership, let alone go backwards.

We set a goal of 300 new members this year. How well that effort succeeded can be shown by the fact that we have actually taken in during the year 404 new members, and have on file applications from 23 potential members. Due to illness in the headquarters office during the last two months it has been impossible to process these through in the usual orderly manner, which means about 60 days. If all these are passed, our total membership in spite of deaths, resignations and cancellations, will then be over 3300 which is a new all-time high and an additional reason for celebrating our Golden Anniversary.

It seems to me that this Society should have at least 5000 members, as there are many potential members who have probably never been approached.

I was quite interested in reading Pres. F. R. Still's Report at the 25th Annual Meeting here in New York, at which time we had 854 Members. He commented on the need for greatly increasing the membership and appealed for a membership of 1500. The members responded by adding 273 new members in the first 4 months. I happened to be one of them (1230 Jan. 1, 1920).

Fifteen years later, again in New York, Pres. W. T. Jones commented on the membership and while we then had 1900 members, he felt that there were at least 2000 men who were well qualified for membership who did not belong to the Society.

If he could visualize a membership of 4000 at that time, certainly with the tremendous increase in our profession and industry in the last 10 years a potential membership of 5000 is by no means beyond the realm of possibility.

Let's work with the thought in mind that this can be accomplished in the next three years.

Fourth—Chapters: I had hoped this year to be able to visit all the Chapters, but unfortunately, due to conflicting dates, did not quite make all of them, despite the fact that I traveled nearly 30,000 miles, which is quite a bit of traveling under wartime conditions. Mrs. Blankin accompanied me for over 20,000 miles and again we wish to express our sincere thanks to all the Chapter officers and members and their wives for their most gracious hospitality. I only wish that every member of the Society could make the same trip and actually get to know the individual members as you meet them under these circumstances. They simply devote their entire time to you during your stay in their city and do everything possible to make it most pleasant and entertaining. Most of the Chapters were functioning in excellent order, holding regular meetings that were well attended. A very few felt that because of war work, rationing, and loss of members, due to temporary change of working location, as well as induction into the Armed Services, interest could not be maintained, and had suspended most of their meetings.

We held an excellent meeting in each case, at which time it was pointed out to them the necessity for continuing to hold regular meetings to keep their Chapter organization together, and furthermore that they were overlooking the possibility of securing new members under wartime conditions. Many were seeking admission but waiting for someone to ask them to join.

On checking back I was pleased to learn that these Chapters were holding regular meetings, and as a result members from that area have proposed quite a few new members into the Society. One meeting that I attended of a Chapter that had suspended operations, resulted in eight applications that night.

In addition to visiting the Chapters, I held meetings with our membership in Baltimore, Denver, San Antonio, and Indianapolis, with the hope that new Chapters might be conceived.

At Denver we had a meeting under the auspices of the Colorado Section of the *ASME* with a large attendance and 47 potential members of our Society in that group. I had hoped to have a new Chapter there before this, but unfortunately to date it has not materialized.

We should have Chapters in Baltimore and San Antonio, and I am sure that in due time this will come about.

With a Chapter in Baltimore we would probably increase our membership by at least 100. In fact, even more than that if we use what happened in Indianapolis as a guide.

A meeting was held with our members in Indianapolis early in September, with Life Member, Joseph G. Hayes, acting as Chairman. As a result of that meeting a Chapter was organized and officers were elected, with an application for a Charter for the Indiana Chapter signed by 24 members. This was granted by the Council early in October, and November 1 set as the date for the official presentation of the Charter, and the Fall Council Meeting was set for October 31 in Indianapolis.

Then a most inspiring thing happened—the members in Indiana started soliciting new members. Two days before the meeting I had a letter from one of their officers and he was quite proud of the fact that they had 27 applications for membership and 2 applications for re-instatement. But that was only a start, for then the new Chapter became a snow-ball rolling down hill so that on Charter Night, November 1, 1943—a new all-time record as to size of Chapter at its start was made by the Indiana Chapter with 81 Charter Members in attendance, and so became the 32nd Chapter in our long roll of Chapters. We had 38 members in Indiana as of September. Since that date 61 new applications have been turned in, or a total of 99 members now in Indiana.

If nothing else had happened during this year, that would have been inspiration enough for all of the work in 1943.

If it can be done in Indianapolis it can also be done in the other cities I have mentioned and several others located strategically throughout the country, like Columbus, Ohio; Newark, N. J.; Salt Lake City, Utah; Syracuse or Central New York; Louisville, Ky.; and a central location in Pennsylvania.

It was proposed this year that all members be assigned to some Chapter. I don't think this practical until we have Chapters at least at the various points I have indicated.

From my experience this year I think it is desirable for the President to visit as many of the Chapters as it is physically possible for him to do. The Chapters look forward to the President's Annual visit and the opportunity to make personal contact with the man who is actually the symbol of the Society. Remember that this is the only actual contact many of our members have with the Society, except through publications. This might be placing a great burden on the President especially as we add more Chapters, but it is important to remember that in assuming the great honor of this Office you also accept the responsibility and the need of devoting, except for the summer months, practically your entire time to the work of the Presidency.

This year we prepared for each Chapter visible Index Systems for keeping complete records of their members and Minute Books for keeping standard minutes with duplicate copies for headquarters office. I think we should continue to give more and more assistance to the Chapters, particularly in the way of speakers—not limit them to two speakers a year, but make it possible for them to have

additional ones with a special message or timely technical information. We could make up a list of topics to be discussed in all the Chapters with inter-change of ideas.

It will help build up their morale by making their meetings much more interesting and attract more new members into the Society. We get most of our members through the Chapters, so why not concentrate on giving them a greater desire to join. The Chapter Relations Committee should be one of our most important Committees, a greater allocation should be provided in its Budget so that it can do everything possible to make our Chapters stronger and more active units of the Society.

Fifth—The Guide: This year The Guide exceeded all expectations, both as to sales and advertising. The Guide Publication Committee will report later with complete factual information.

The Committee is to be congratulated for the splendid work they have done in re-editing The Guide and rewriting the necessary Chapters to bring it up to date with current research information.

Sixth—War Service: The Society has contributed much to the War effort. I have mentioned the all-out subscription to War Bonds, and we now have 332 Members in the Service of the United Nations. Two of our Members have paid the supreme sacrifice. I particularly refer to Flying Officer H. L. Temple, of the Royal Air Force, from London, England and Pilot Officer Phil. Foster of the Royal Air Force from the Manitoba Chapter, Canada.

Through our War Service Committee we have contributed much to the National Fuel Rationing Programs, and our individual members throughout the country have rendered yeoman service in helping to make these programs work.

We have been the leaders in the Fuel Conservation Program and practically all our recommendations have been adopted nationally. Our pamphlet on 57 Ways to Save Fuel has been distributed nationally by the Office of Price Administration.

Our individual members have contributed much to the construction period when we were building the Arsenal of Democracy, cantonments, and flying fields all over this hemisphere. The Research Laboratory was early placed at the disposal of the Government and has conducted vital research work for the United States Navy.

If this Administration has achieved any medium of success during the War Year 1943 it has not been because of the work of any one individual, but rather the cooperative efforts of all. I ask the same loyal support for the incoming administration.

I have been blessed with an exceptionally fine Council; the Committee Chairmen and their Committees are all to be commended; the Chapters and individual members have all played their part. I wish time would permit me to mention each one by name.

I have had the loyal and faithful cooperation of the New York Staff.

I cannot close without paying special tribute to Secretary A. V. Hutchinson, who seems to never sleep but works day and night for the advancement of the Society and is always at the right-hand of the President, ready to help with all the constant details that require attention from day to day.

It has been a real pleasure and a privilege to serve you for the past year, yes—for the past 25 years. May I continue to do so, and I hope I can be here for the Diamond Jubilee 25 years hence.

President Blankin referred to the Report of the Council as follows:

Council Report

The Council held its organization meeting, January 27, 1943, in Cincinnati, O., and Pres. M. F. Blankin announced the appointment of Council and Special Committees. A. V. Hutchinson was reappointed Secretary. The recommendations of the Committee on Research to have Prof. C. M. Humphreys continue as Acting Director of the Research Laboratory were confirmed. Depositories for Society funds were selected in New York, Brooklyn, and Toronto, and the Finance Committee was authorized to retain a Certified Public Accountant to audit the Society's books.

The Budget for 1943 as presented by the Finance Committee provided for an estimated income of $84,300 and an estimated expenditure of the same amount, exclusive of research funds.

Plans for the Semi-Annual Meeting 1943 were discussed and the invitation of the Pittsburgh Chapter was accepted.

Employment of a Technical Secretary was authorized and a special committee was appointed to select a candidate.

At the April 18 Council Meeting in Chicago the Secretary was authorized to prepare a uniform system for keeping Chapter records and Minutes and a Kardex Record for accounts.

Announcement was made of the appointment of Carl H. Flink as Technical Secretary effective, March 1. The activities of the War Service Committee were reviewed by Chairman John Howatt.

The Committee on Research presented five suggestions with reference to the future research program and the Council authorized the creation of the position of Director of Research, and requested the Committee on Research to engage a Director for a three-year term to carry out the program that it had prepared.

The Finance Committee was authorized to determine whether an employees benefit plan would be desirable. The Committee also submitted the Budget in revised form to conform with the newly installed bookkeeping system.

Two meetings of the Council were held in Pittsburgh, Pa. in June and the Secretary was authorized to negotiate a new lease for headquarters at 51 Madison Ave., New York, and the recommendations of the Finance Committee were adopted regarding dues rates for members in service. It was voted to invest some of our Canadian Funds in the Fourth Canadian Victory Loan.

A comprehensive plan for handling codes and standards of the Society was submitted by the Standards Committee.

Nominations for members to serve on the Committee on Research were announced and President Blankin appointed the Chapter Development Committee consisting of Messrs. W. A. Russell, Albert Buenger and C. E. Price, to study the chapter problems covered by a resolution of the Northern Ohio Chapter.

Announcement was made of the appointment of Cyril Tasker as Director of Research, effective October 1, 1943.

In November the Council met in Indianapolis, Ind., on the occasion of the organization meeting of the Indiana Chapter, and announced the dues rate for 1944. It authorized the purchase of three, *Series F*, U. S. War Savings Bonds and three bonds of the Fifth Canadian Victory Loan.

A change in the fiscal year was adopted and the Finance Committee presented the Budget for the period November 1, 1943 to October 31, 1944 which showed a total estimated income including Research of $140,878 and total expenditures of $135,878.

Detailed plans for the 50th Annual Meeting were announced and the Council indicated its desire to have Charter Members and all Past Presidents in attendance. The report on the F. Paul Anderson award indicated that Lt.-Comdr. F. C. Houghten was the unanimous choice for this award.

The report from the Committee on Research indicated that new quarters for the Laboratory would be required on or before the termination of our present agreement with the Bureau of Mines and a special committee was appointed to investigate other locations that had been offered.

Life Memberships were granted to ten members who were eligible effective January 1, 1944.

The concluding Council Meeting was held in New York, January 30, 1944 and all pending business was disposed of and final reports of all Council committees were received. During the year routine action was taken on all resignations, cancellations for non-payment of dues, and reinstatement of members.

In review the Council had a year of unusual activity, faced many problems, and made several decisions that will ultimately affect the future of the Society.

Respectfully submitted,

THE COUNCIL

The Report of the Secretary was then submitted as follows:

Report of Secretary

It is the duty of the Secretary to report on activities of the headquarters office for the past year, and 1943 was crowded with many special projects. Because of the necessity for giving greater service to the members, largely engaged in war activities; cooperation with government agencies confronted with the fuel crisis; many changes in office procedure, required by the installation of new accounting methods; a revised method of handling codes and stand-

ards, and the active work of many special committees, made 1943 one of the most unusual years in the Society's history.

It is notable that the Society's records show 334 members in active military service and their names have been placed on the Society's Service Roll which is published periodically. It is unfortunate that there is no way of getting a complete record of the services rendered by the members who are not in uniform, but who are doing such effective work in helping to win the war.

Our records show that a substantial growth of the Society continues and that the present total of 3342 members on the roll is an all-time high. One new Chapter was organized during the year and the Indiana group did a phenomenal job of starting November 1 with the largest initial charter membership of any Chapter in the Society.

It may be interesting to glance backward through the years and take note of the fact that on the occasion of the Society's 25th Anniversary in 1919, the slogan was, "One Thousand Members on the 25th Anniversary Meeting of the Society." This was accomplished with 1058 on the rolls. It is also of interest to read in Transactions that on the third anniversary of the Society in 1897, the President, Prof. R. C. Carpenter, was suggesting a revision of the stringent membership requirements, which he thought would keep the Society exceedingly small. He visualized a national Society at least 500 to 1000 members. The 500 total was not achieved until 1914 and the peak was attained five years later.

As we approach the 50th Anniversary year, it is significant that this also marks the 25th anniversary of the establishment of the Society's Research Laboratory. In 1943, it became apparent that it would be necessary to move in the near future from our present location in Pittsburgh and a special committee was appointed to select a new location for the Laboratory.

In March the Council appointed a new Technical Secretary, Carl H. Flink, and in October the Council created the position of Director of Research and approved the appointment of Cyril Tasker to this position. The activities of both have been carried on at the headquarters office.

In the reports of many committees that will be given at this meeting, it should be possible to visualize the volume of correspondence, publication activity, membership and special services that have been carried on by the headquarters office staff. The growth of the Society to its present high level of activity has created many problems. The present financial position of the Society is sound and analysis of the financial statement prepared by the Society's Certified Public Accountant will show that dues collections are at a satisfactory level, that reserve funds are adequate and are somewhat above the constitutional requirement.

The Council has held seven meetings during the past year and the Society has held two regular meetings in 1943, at Cincinnati and Pittsburgh. It has been the policy of the Council during the war period to schedule meetings which might be helpful in giving assistance to its members and to government agencies. Programs have been streamlined to meet wartime needs, but it has been noticeable that heavier registrations have been recorded at these meetings, the technical sessions have been better attended and the number of technical committee meetings have greatly increased in volume.

This year, the Council gave special recognition to two of the staff members who completed 20 years' service with the Society. Although many unusual and difficult problems have been encountered under wartime conditions the staff has endeavored to meet all of the unusual demands and carry on the work effectively. I should like to commend the activities of all my associates of the headquarters office staff who have worked so effectively to meet the exacting demands of 1943 and who greet the 50th year of the Society's service with a desire to make it a memorable one.

Respectfully submitted,

A. V. HUTCHINSON, *Secretary.*

President Blankin called upon W. A. Russell, chairman of the Chapter Development Committee, who presented his prepared report as follows:

Report of Chapter Development Committee

The full report of the Chapter Development Committee was put in printed form and mailed to the entire membership on January 10, 1944.

It will be recalled that this Committee was appointed at the Pittsburgh meeting of the Society in June, 1943, on motion of the Northern Ohio Chapter, and was given the assignment of studying the subject of Chapter-Society relationship and specifically to investigate:

1. A plan whereby each member of the National Society becomes a member of a local chapter;
2. A plan for the geographical boundaries of each chapter, thus determining its membership on a convenient geographical basis;
3. A schedule of national dues and chapter dues, taking into consideration the possible financial support of the chapters by the National Society;
4. Such other matters that may be considered pertinent to this subject.

Your Committee held three meetings—one in Pittsburgh at the time of appointment, one in Indianapolis in September and one in Cincinnati in December. At the first, the general plan of procedure and organization was adopted; at the second, all the details of the subject and the information needed for consideration were thoroughly explored and the decision made to go to the entire membership for an authoritative expression of opinion on the essential problems involved; at the third, the results of our investigations were analyzed, the conclusions drawn up and the report written. Voluminous correspondence between members of the committee and members of the Society supplemented the discussions and studies at the meetings themselves.

In our preliminary study of the subject it immediately became apparent that to make every member of the National Society a member of a local chapter and rebate chapter dues or provide some other form of financial support of chapters by the National Society would cost money. Chapter dues now range from $2.00 to $7.00 and three-fourths of the chapters are in the $3.00 to $5.00 bracket. Thus, the ability of the National Society to finance such a program had to be determined.

It was determined that Society income from the present $18.00 national dues was insufficient. In fact, these dues have failed to meet regular operating expenses in each of the years 1939-1942, inclusive. Other Society income is ear-marked by the By-Laws and Rules for research, endowment and reserve funds and, aside from the question of sufficiency, is, therefore, not available unless the by-laws and rules are changed. If they are changed and this kind of income is used for some form of Chapter subsidy it would mean that some of the Society's present research plans and services to members would have to be discontinued or curtailed.

In short, any plan such as proposed, requiring financial support from the National Society, must be accompanied by an increase in the national dues of every member or by a curtailment of present Society services and activities. And that, in the opinion of your committee, must be acceptable to the membership.

All members will recall the letter of explanation and questionnaire sent out to determine the acceptability of either of these two methods of establishing a plan whereby each member of the National Society becomes a member of a local chapter. The specific questions—Are you in favor of Chapter subsidy with increased national dues?—and—Are you in favor of Chapter subsidy without increased national dues but with curtailed services to members?—were asked.

Every member was sent the questionnaire. The very high return of 50 per cent was the result. Based upon the returns—which, according to all research experience, are more than ample to accept as a reflection of the wishes and opinions of all members—68 per cent of the membership does not want an increase in national dues for the purpose of chapter subsidy; 30 per cent does; 2 per cent has no opinion; and 83 per cent of the membership is opposed to curtailing present Society services in order to subsidize chapters; 14 per cent is for it; 3 per cent has no opinion.

The complete tabulation of these returns . . . by states, by chapter members and by non-chapter members . . . is reproduced in the committee's full, printed report. Chapter members and non-chapter members were heard from in direct proportion to their respective numbers in the Society and the votes of each group paralleled those of the other very closely.

Your committee, therefore, feels that the membership has spoken with full knowledge of the benefits and shortcomings of such a plan and it must report as a result, that a plan whereby each member of the National Society becomes a member of a local chapter is not feasible, inasmuch as the only two methods by which such a plan could be put in operation are not acceptable to the membership.

Because this is the situation your committee has not endeavored to set up a plan for the geographical boundaries of each chapter and has no plans for a schedule of national

dues and chapter dues. Other matters pertinent to the subject are discussed at some length in the full, printed report. Unless there are questions from the floor, there seems to be no need to go into them here.

Before asking your acceptance of this report, your Committee would like to refer to Article B-1V—Admission Fees and Dues in the Constitution, By-Laws and Rules of the Society. The admission fee and annual dues are there prescribed as "determined by the Council until 1945 and thereafter . . ." the dues shall be $25.00, etc. At that time, of course, the feasibility of such a plan as we have been asked to study would assume a different aspect, but the Committee calls to the Council's attention, as perhaps bearing on the general subject of dues, this decisive note against increased dues. While the opposition to them is in connection with a plan for chapter subsidy, it may or may not be construed as opposition to increased dues for any reason.

Your Committee on Chapter Development now requests confirmation of its conclusion that any plan for Chapter subsidy by the National Society is not feasible at this time and acceptance of its report; and it respectfully asks that it be discharged as a committee of the Society. I so move.

W. A. RUSSELL, *Chairman*,
ALBERT BUENGER,
CHAS. E. PRICE.

L. T. Avery, Cleveland, Ohio, stated that the Committee's report should be accepted and the Committee should be discharged with sincere thanks. He reviewed the history of the committee and referred to its excellent work in obtaining the opinion of the Society. He raised several questions which might be worthy of consideration such as: Would any amount of money, say $15.00 or $3,000.00 annually, from the surplus funds of the Society as at present operated, do more good if used for Chapter support than if added to Reserve Funds or to Research Funds? Would it be possible that 500, 1000 or 2000 additional members be secured through proper support of the Chapters?

F. W. Legler, Minneapolis, Minn., referred to a discussion held in the Minnesota Chapter with reference to the Chapter Development Program in which the point was brought out that financial support of Chapters by the national Society would reduce the independence of the Chapter in the matter of local expenditures.

On motion of W. A. Russell, seconded by C. E. Price, it was voted that the Chapter Development Committee report be accepted and the committee discharged with thanks for their painstaking and effective work.

Paul D. Close, Chicago, Ill., presented the Report of the Guide Publication Committee, which was received with a rising vote of thanks:

Report of the Guide Publication Committee

While wartime paper conservation measures have prevented any expansion of the text of the 22nd edition of the Heating, Ventilating and Air Conditioning Guide, it has been possible to add desirable new material by condensing present Guide text without sacrificing essential data. A new chapter dealing with Marine Heating and Ventilation has been added because of the increasing demand for such data.

The 1944 Guide is presented by the Guide Publication Committee with many important changes and additions which conform to the established policy of providing Guide users with up-to-the-minute data on the latest proven developments in the art and industry.

The tables of heat transmission coefficients in Chapter 4 have been completely revised and rearranged to include values for important materials and constructions not previously listed and to eliminate obsolete or seldom used constructions. The factors for computing the coefficients, however, are substantially the same. Some changes have been made in the chapter on Fundamentals of Heat Transfer in the interest of simplification.

Revised information and tabular data on stratification of air in rooms with high ceilings have been incorporated in the chapter on Heat Load. Moisture permeability data for various materials have been added to the chapter on Cooling Load. New data on fuels and the combustion process have been added to Chapter 8. The latest degree-day data compiled by the Weather Bureau, together with new data on predicting residence heat loss, are included in the chapter on Estimating Fuel Consumption.

Chapter 9 on Chimneys and Draft Calculations is largely new, having been brought in line with recent developments and includes a revised discussion of chimneys for gas heating. Chapter 10, dealing with Automatic Fuel Burning Equipment, has been extensively revised and contains new data on mechanical stokers, oil burner and gas-fired heating equipment, as well as important information on combustion processes, appliance adjustments, and furnace design. The section on Expansion Tanks in Chapter 16 has been rewritten.

The chapter on Pipe, Fittings and Welding contains entirely new data on commercial pipe dimensions as well as current information on threading practice. Chapter 19, Gravity Warm Air Furnace Systems, has been completely rewritten and brought up to date, and presents a simplified method of designing gravity warm air systems.

Chapters 24, Cooling, Dehumidification and Dehydration, and 27, Spray Equipment, have been thoroughly revised to improve the presentation of the material. Revisions and additions to Chapter 33, Sound Control, involve changes in the data on fan noises, clarifying the information on elbow attenuation and amplifying the data on absorption for plate cells. Chapter 34, Automatic Control, has been rewritten to obtain a fundamental approach to the subject of controls, and sections have been added to cover automatic control terminology and types of controllers. Chapter 37 on Air Conditioning in the Treatment of Disease contains a considerable amount of new information and data on various phases of this subject, including sections entitled, Reducing Explosion Hazard in Operating Rooms, Operating Room Conditions, Sterilization of Air, Cold Therapy and Oxygen Therapy.

New data on conduits, meters, piping of meters and economizers, and revised rules for utilization of heat have been incorporated in Chapter 43, District Heating. Chapter 46 on Hot Water Supply has been modified and includes revised information on hot water supply piping as well as additional data on computing the area of heat transmitting surface for instantaneous heating coils.

State code references in Chapter 48 have been corrected to 1944. Chapter 49 is a new chapter on Marine Heating and Ventilation and contains essential information on the design of heating and ventilating systems for ships.

As has been customary in the past, much of the copy, representing well established practice, has been carried over from previous issues to the Heating, Ventilating and Air Conditioning Guide 1944. Acknowledgment has been made in previous issues of those who have contributed. Because of the difficulties in many cases of serving under the handicaps of wartime conditions, special credit is due contributors to this edition of the Guide, whose names are listed in the preface.

The Catalog Data Section is broader in scope, and presents a greater variety of products by an increased number of manufacturers. The many pages of condensed data on equipment will be helpful in design, installation, and selection of equipment. This section is fully indexed and coordinated with the technical data by use of numerous cross references.

The 1944 edition of the Guide is presented with the anticipation that it will be even more useful than preceding editions and that it will provide a definite contribution to the advancement of the art and science of heating, ventilating and air conditioning.

GUIDE PUBLICATION COMMITTEE.
Paul D. Close, *Chairman*,
Thomas Chester, S. Konzo,
John James, C. S. Leopold,
Carl H. Flink, Technical Secretary.

R. A. Wasson, New York, N. Y., chairman of the Board of Tellers, presented the results of the ballot for officers and members of the Committee on Research as follows:

Ballots for Officers

Total Ballots received	1020
Total Legal Ballots	1002
President—S. H. Downs	1000
1st Vice-President—C.-E. A. Winslow	998
2nd Vice-President—Alfred J. Offner	999
Treasurer—L. P. Saunders	1002
Members of Council (three-year term):	
C. M. Ashley	999
L. T. Avery	998
L. E. Seeley	998
G. D. Winans	1001

(Scattering votes for other candidates.)

Ballots for Committee on Research

Total Ballots received	1020
Total Legal Ballots	1002
Three-Year Term:	
C. M. Ashley	999
F. E. Giesecke	1002
F. C. McIntosh	1001
G. L. Tuve	1002
T. H. Urdahl	1001
Two-Year Term:	
John James	999

(Scattering votes for other candidates.)

President Blankin stated that 1020 ballots had been cast for Officers, Council members, and for members of Committee on Research, which indicated a very real interest on the part of the members of the Society.

President Blankin expressed the Society's appreciation of the kind congratulatory messages and expressions of best wishes which had been presented.

The first session adjourned at 12:15 p. m.

Second Session—Monday, January 31, 2:30 P. M.

The second session was called to order by President Blankin at 2:30 p. m. in the Georgian room.

The report of the Committee on Research for 1943 was presented by Chairman C. M. Ashley, Syracuse, N. Y. (published in February 1944 Journal Section, Heating, Piping & Air Conditioning).

E. K. Campbell, Kansas City, Mo., presented the Report of the Treasurer, which was received and filed.

Report of the Treasurer

It is my privilege at this time to make a very favorable and pleasing report on the condition of our Society treasury. It is my privilege for the reason that, while the treasurer is in the limelight, the chairman of the Finance Committee does the work. I can say to you that the Finance Committee has done fine work during the past year. J. F. Collins, Jr., as chairman, with the approval of the balance of the committee, has changed and improved the set-up of the bookkeeping, has changed and improved the arrangement with the auditors, all of this being in connection with the change in the fiscal year. This change in the fiscal year affects no member, but makes it easier for the Council to have correct information for its January meeting. Mr. Collins has simplified the entire statement and made it more easily understandable.

Your president, in his report, gave most of the figures, and I can only add the statement that all of the investments of the Society are now in U. S. Government securities, or in securities of the Government of Canada. I may explain that, because of the adverse exchange rates, the Canadian members' dues are deposited in a Canadian bank.

The management of your Society has been good; the funds have been carefully watched; and now, the danger which befalls any Society like ours, comes, as it does to an individual. The average individual can stand adversity much better than he can stand prosperity. When money is easy, the temptation to spend grows. And so, I warn you that, in our Society, there will come proposals to spend money for this, or that, or some other idea, which may or may not be worthy in itself, but which might easily be too much of a drain on the national treasury at times when it is hard for members to pay their dues, and when the Society loses members by the hundreds on that account. There was a time when our membership dropped from around 1800 to about 1200 because of the depression. We can expect such times again, and our expenditures must be set up in such a way that they can be reduced as necessity requires.

The various proposals which are likely to come for the spending of money remind me of two women discussing their husbands. One told how wonderfully generous her husband was—if she wanted a new car, or a new coat, all she had to do was to mention it. She went on to some length until her friend interrupted with, "Well, does he give you all the *money* you want to spend?" The reply was instantaneous—*there ain't that much.* So, when these proposals come to raid the national treasury for this or that, just remember the reply *there ain't that much,* because the time will come in the next depression—maybe 10 or 15 years from now—when there will not be that much. The Society can be wrecked by improper and too liberal management between now and then.

E. K. CAMPBELL, *Treasurer.*

Accountants' Report

Tusa & La Bella
Certified Public Accountants
52 William Street
New York

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS,
51 Madison Avenue,
New York, N. Y.

Gentlemen:

Pursuant to your request, we examined the books of account and records of the American Society of Heating and Ventilating Engineers—New York, N. Y., and the related Funds for the period from January 1, 1943, to October 31, 1943, and submit herewith our report.

The audit covered a verification of the assets and liabilities as of the close of business October 31, 1943, and a review of the operating accounts for the period then ended. For the period audited the recorded cash receipts were traced into the depositories; the cancelled bank checks were inspected, compared with the cash records and supported by payment vouchers; also the dues income and interest income from savings accounts and securities were accounted for.

A Balance Sheet reflecting the financial condition of the Society as of the close of business October 31, 1943, is submitted herewith and your attention is directed to the following comments thereon:

CASH

Cash on Deposit as reflected in the attached cash schedule was verified by direct communication with the banks and the balances reported to us were reconciled with those on the books of the Society. The petty cash was verified by count.

MARKETABLE SECURITIES

The securities, shown on the subjoined schedule, were verified by direct communication with the Bankers Trust Company, where same are deposited for safe-keeping. This asset has been included in the Balance Sheet at the cost of acquisition plus the accumulated and accrued interest earned thereon.

CERTIFICATE OF INDEBTEDNESS

The certificate of indebtedness issued to the Society by Farrar & Trefts, Inc., was verified by inspection of the instrument.

ACCOUNTS RECEIVABLE

A list of the membership dues receivable as of October 31, 1943, furnished to us by the management was checked to the individual ledger cards and found in agreement with the General Ledger Control. These unpaid dues were aged and summarized as follows:

Dues invoiced during 1943	$ 6,993.00
Dues invoiced during 1942	1,740.00
Dues invoiced during Prior Years	361.50
TOTAL	$ 9,094.50

Amounts due from Guide advertisers and other debtors were verified by trial balance of the individual ledger accounts and found in agreement with the General Ledger Control.

The reserve for dues and sundry accounts receivable found on the books of the Society are ample to cover losses that might result from uncollectible accounts.

INVENTORIES

The emblems on hand were counted by us, and the inventories of paper and transactions were verified by communication with printers.

These inventories were priced and computed by us. The following transactions were reported to us.

Volume	Year	Quantity	Price	Amount
Prior	Prior	1350	$1.00	$1,350.00
44	1938	26	1.58	41.08
45	1939	122	1.66	202.52
46	1940	79	1.25	98.75
47	1941	85	1.32	112.10
47	1941	150 (unbound)	.96	144.00
48	1942	90	1.42	127.80
48	1942	150 (unbound)	1.07	160.50
			Total	$2,236.75

PREPAID TRAVELING

There were on hand railroad scrip books having a value of $24.46 which are to be turned in for refund.

PERMANENT ASSETS

Furniture, fixtures and library are shown herein at the book values without appraisal by us; we did, however, provide for depreciation of furniture and fixtures at the rate of ten per cent per annum.

DEFERRED CHARGES

During the current fiscal period disbursements were made towards the editing and promotion of the 1944 Guide as itemized in the Guide budget which we have deferred to the Guide operations of the ensuing fiscal year.

ACCOUNTS PAYABLE

All purchase invoices found on file that were applicable to the operations of the current fiscal period were listed by us and the proper liability therefor has been reflected in the attached balance sheet.

In addition, there is due the Research Fund on dues collected from members and associates during the current period the sum of $994.96 and to the Reserve Fund the sum of $456.25 for initiation fees collected in the month of October, 1943, plus interest on Treasury Bonds.

DEFERRED INCOME

Trial balances taken of the Dues Receivable disclosed prepayments made by members and candidates for membership. We have shown these on the subjoined balance sheet as deferred income.

RESERVE FOR PUBLICATIONS

In accordance with the provision made in the 1943 budget, we have included in the attached balance sheet a reserve of $3,400.00 to cover the publication of the 1943 Transactions—Volume 49.

FUNDS

An analysis of the following funds reflecting the changes that

occurred in these accounts during the period from January 1, 1943, to October 31, 1943, is included herein:

General Fund
Reserve Fund
Endowment Fund
F. Paul Anderson Fund

There is included herein a complete financial report as prepared for the Committee on Research, setting forth the financial position of the Research Laboratories as of the close of business, October 31, 1943, and the results from operations for the period from January 1, 1943, to October 31, 1943.

Respectfully submitted,
Tusa & LaBella,
Certified Public Accountants.

Dated December 31, 1943.

BALANCE SHEET

American Society of Heating and Ventilating Engineers—
New York, N. Y.
October 31, 1943

ASSETS

GENERAL FUND				
CASH				
On deposit	$24,629.82			
On hand	100.00	$24,729.82		
In closed bank		380.89	$25,110.71	
INVESTMENTS (AT COST)				
Securities (Market Value $20,700.00)		19,900.00		
ADD: Accumulated interest	800.00			
ADD: Accrued interest	75.00	875.00	20,775.00	
CERTIFICATE OF INDEBTEDNESS				
Farrar & Trefts, Inc.			153.20	
ACCOUNTS RECEIVABLE				
Membership dues		9,094.50		
LESS: 40% for Research	3,418.20			
LESS: Reserve for doubtful	873.84	4,292.04		
		4,802.46		
Advertisers and Sundry debtors	1,485.67			
LESS: Reserve for doubtful	962.66	523.01	5,325.47	
INVENTORIES				
Transactions—Copies		2,236.75		
Transactions—Paper		283.90		
Guide—Paper		2,561.11		
Emblems		58.75	5,140.51	
PREPAID TRAVELING				
Railroad scrip			24.46	
PERMANENT				
Library		300.00		
Furniture and fixtures	2,744.14			
LESS: Reserve for depreciation	1,489.86	1,254.28	1,554.28	
DEFERRED CHARGES				
Guide costs		5,754.97		
Prepaid H.P.A.C. subscriptions		966.30	6,721.27	$64,804.90
RESERVE FUND				
Cash on deposit			1,913.89	
Due from General Fund			456.25	
Securities at cost (Market value $52,241.82)		50,719.06		
ADD: Accumulated interest	1,272.50			
Accrued interest	33.75	1,306.25	52,025.31	54,395.45
ENDOWMENT FUND				
Cash on deposit		2,255.11		
On hand for deposit		15.00	2,270.11	
Securities at cost (Market value $22,883.70)		25,153.65		
ADD: Accumulated interest	467.50			
Accrued interest	120.00	587.50	25,741.15	28,011.26
F. PAUL ANDERSON FUND				
Cash on deposit				1,098.06
				$148,309.67

LIABILITIES AND FUNDS

GENERAL FUND			
LIABILITIES			
ACCOUNTS PAYABLE		$ 1,918.72	
TAXES WITHHELD		274.91	
ACCRUED ACCOUNTS			
Additional compensation to employees		3,654.23	
DUE TO RESEARCH		994.96	
DUE TO RESERVE FUND		456.25	
DEFERRED INCOME			
Prepaid membership dues	$570.20		
LESS: 40% prepaid to Research	176.20	$394.00	
Dues prepaid by candidates for membership		283.63	677.63
RESERVE FOR PUBLICATIONS			
Transactions (1943) Volume 49		3,400.00	
TOTAL LIABILITIES		$11,376.70	
GENERAL FUND		53,428.20	$64,804.90

NOTE "A"—This Balance Sheet is subject to the comments contained in the letter attached to and forming a part of this report.

RESERVE FUND		
Principal	53,006.10	
Unexpended income	1,389.35	54,395.45
ENDOWMENT FUND		
Principal	27,432.99	
Unexpended income	578.27	28,011.26
F. PAUL ANDERSON FUND		
Principal	1,085.83	
Unexpended income	12.23	1,098.06
		$148,309.67

STATEMENT OF INCOME AND EXPENSES

American Society of Heating and Ventilating Engineers—
New York, N. Y.
For the Period from January 1, 1943 to October 31, 1943

INCOME

FROM MEMBERS				
DUES—RENEWALS				
Members and Associates	$45,423.00			
LESS: Cancellations	1,641.00	$43,782.00		
LESS: 40% to Research Laboratory		17,512.80	$26,269.20	
Junior and Student members		1,871.00		
LESS: Cancellations		150.00	1,721.00	$27,990.20
DUES—NEW MEMBERS				
Members and Associates		3,439.50		
LESS: 40% to Research Laboratory		1,375.80	2,063.70	
Junior and Student members			293.50	2,357.20
TOTAL DUES				30,347.40
INITIATION FEES				2,389.00
INCOME FROM SALES OF EMBLEMS AND CERTIFICATES FRAMES				74.16
TOTAL INCOME FROM MEMBERS				32,810.56
FROM OTHER SOURCES				
Editorial contract		13,333.30		
LESS: Members' subscriptions		4,831.48	8,501.82	
Profit from sales of books, reprints, etc.			443.03	
Sale of transactions			859.61	9,804.46
FROM INVESTMENTS				
Interest from savings accounts			82.92	
Interest from securities			158.15	
Interest from certificate of indebtedness			3.74	244.81
TOTAL INCOME				42,859.83

EXPENSES

OFFICERS AND COUNCIL EXPENSES				
President's Fund		1,742.36		
Council meetings, travel		2,062.12	3,804.48	
COUNCIL COMMITTEES				
Membership		366.45		
Meetings		1,247.49	1,613.94	
SPECIAL COMMITTEES				
Chapter Relations—Speakers' Bureau		177.18		
Chapter Relations—Delegates' travel		1,937.93		
Chapter Relations—Chapter records		186.34		
War Service		671.17		
Chapters development		256.88	3,229.50	
			8,647.92	42,859.83
DIRECT EXPENSES				
A.S.A. membership		100.00		
Transactions		4,774.64		
Membership certificates		167.22		
Initiation fees to Reserve Fund		2,389.00		
Medals and awards		20.00	7,450.89	
APPORTIONABLE EXPENSES				
Salaries—Secretary and staff		16,516.50		
Provision for additional compensation		3,471.52		
Traveling—Secretary and staff		1,002.15		
Rent and light		3,004.78		
Telephone		576.04		
Telegrams		99.67		
Postage		1,563.49		
General printing		694.77		
Addressing and address changes		75.70		
Office supplies		478.87		
Professional services		600.00		
Depreciation of furniture and fixtures		274.41		
Bank charges		61.90		
General office expenses		524.91		
		28,944.71		
LESS: 30% applicable to Guide		8,683.41	20,261.30	36,360.08
NET INCOME FROM SOCIETY ACTIVITIES				$ 6,499.75

BUDGET COMPARISON—SOCIETY ACTIVITIES

American Society of Heating and Ventilating Engineers—New York, N. Y.

For the Period from January 1, 1943 to October 31, 1943

	Actual	Budget Provision	Increases Decreases
INCOME			
MEMBERSHIP INCOME			
RENEWALS			
100—Dues—Members	$16,775.94	$14,580.00	$ 2,195.94
101—Dues—Associates	8,317.76	7,560.00	757.76
102—Dues—Juniors	1,676.00	2,000.00	324.00
103—Dues—Students	45.00	75.00	30.00
	26,814.70	24,215.00	2,599.70
NEW MEMBERS			
104—Dues—Members	1,339.80	1,080.00	259.80
105—Dues—Associates	723.90	540.00	183.90
106—Dues—Juniors	230.00	200.00	30.00
107—Dues—Students	63.50	15.00	48.50
	2,357.20	1,835.00	522.20
TOTALS	$29,171.90	$26,050.00	$ 3,121.90
108—Initiation fees	2,389.00	1,700.00	689.00
109—Income—Emblems	14.42	20.00	5.58
110—Income—Certificate frames	59.74	25.00	34.74
TOTAL INCOME FROM MEMBERS	31,635.06	27,795.00	3,840.06
INCOME FROM PUBLICATIONS			
115—Editorial contract	13,333.30	13,333.33	.03
116—Guide	1,469.30	70.00	1,539.30
117—Transactions	859.61	500.00	359.61
118—Books and reprints	443.03	250.00	193.03
119—Codes	–0–	25.00	25.00
	16,105.24	14,038.33	2,066.91
INCOME FROM INVESTMENTS			
125—Interest—Savings accounts	82.92	200.00	117.08
126—Interest—Securities	158.15	750.00	591.85
127—Interest—Certificate of indebtedness	3.74	2.00	1.74
	244.81	952.00	707.19
TOTAL CURRENT INCOME	$47,985.11	$42,785.33	$ 5,199.78
COLLECTION OF PRIOR YEAR'S DUES	1,175.50	1,500.00	324.50
TOTAL INCOME	$49,160.61	$44,285.33	$ 4,875.28
EXPENSES			
MEMBERSHIP			
OFFICERS' AND COUNCIL EXPENSE			
150—President's Fund	$ 1,742.36	$ 1,500.00	$ 242.36
151—Council meetings—Travel.	2,062.12	2,500.00	437.88
	3,804.48	4,000.00	195.52
COUNCIL COMMITTEES			
160—Executive	–0–	100.00	100.00
161—Finance	–0–	200.00	200.00
162—Membership	366.45	350.00	16.45
163—Meetings	1,247.49	1,200.00	47.49
164—Standards (includes codes)	–0–	150.00	150.00
	1,613.94	2,000.00	386.06
SPECIAL COMMITTEES			
170—Admission and advancement		150.00	150.00
171—Constitution and By-Laws		150.00	150.00
172—Nomination		150.00	150.00
173A—Chapter Relations—Speakers Bureau	177.18	1,000.00	822.82
173B—Chapter Relations—Delegates Travel	1,937.93	1,500.00	437.93
Chapter records	186.34	500.00	313.66
174—War service	671.17	1,500.00	828.83
Chapter development	256.88	–0–	256.88
	3,229.50	4,950.00	1,720.50
DIRECT EXPENSES			
200—Membership subscriptions H.P.A.C.	4,831.48	4,583.33	248.15
201—A.S.A. membership	100.00	100.00	–0–
202—Transactions	4,774.64	3,400.00	1,374.64
203—Membership roll (Yearbook)	–0–	1,500.00	1,500.00
204—Membership certificates	167.22	200.00	32.78
205—Initiation fees to Reserve Fund	2,389.00	1,700.00	689.00
206—Medals and awards	20.00	100.00	80.00
	12,282.34	11,583.33	699.01
APPORTIONABLE EXPENSES			
210—Salaries—Secretary and staff	16,516.50	21,500.00	4,983.50
211—Provisions for additional compensation	3,471.52	3,000.00	471.52
212—Traveling—Secretary and staff	1,002.15	1,000.00	2.15
213—Rent and light	3,004.78	3,600.00	595.22
214—Telephone	576.04	600.00	23.96
215—Telegraph	99.67	250.00	150.33
216—Postage	1,563.49	1,500.00	63.49
217—General printing	694.77	800.00	105.23
218—Office supplies	478.87	500.00	21.13
219—Addressing and address changes	75.70	150.00	74.30
220—Professional services	600.00	700.00	100.00
221—Bank charges	61.90	50.00	11.90
222—Depreciation on furniture and fixtures	274.41	250.00	24.41
223—General office expense	524.91	500.00	24.91
CREDIT—30% to Guide	8,683.41	10,320.00	1,636.59
	20,261.30	24,080.00	3,818.70
TOTAL EXPENSES	$41,191.56	$46,613.33	$ 5,421.77

STATEMENT OF INCOME AND EXPENSES—GUIDE

American Society of Heating and Ventilating Engineers—New York, N. Y.

For the Period from January 1, 1943 to October 31, 1943

INCOME			
Guide copy sales			$22,672.48
EXPENSES			
FINAL COST OF 1943 GUIDE			
Copy sales promotion	$ 2,640.01		
Indexing	411.92		
Distribution	3,622.06	$6,673.99	
APPORTIONABLE EXPENSES		8,683.41	
CHAPTER MEETING ALLOWANCES		845.78	
SPECIAL APPROPRIATION TO RESEARCH		5,000.00	21,203.18
NET INCOME FROM GUIDE			$ 1,469.30

BUDGET COMPARISON—GUIDE

American Society of Heating and Ventilating Engineers—New York, N. Y.

For the Period from January 1, 1943 to October 31, 1943

	Actual	Budget Provision	Increases Decreases
CURRENT OPERATIONS			
INCOME			
301—Guide copy sales	$22,672.48	$20,500.00	$ 2,172.48
EXPENSES			
FINAL COST OF 1943 GUIDE			
320—Copy sales promotion	$ 2,640.01	$ 2,500.00	$ 140.01
321—Indexing	411.92	350.00	61.92
322—Distribution	3,622.06	1,500.00	2,122.06
TOTAL	$ 6,673.99	$ 4,350.00	$ 2,323.99
326—Apportionable expenses	8,683.41	10,320.00	1,636.59
327—Chapter meeting allowances	845.78	900.00	54.22
Special appropriation to Research	5,000.00	5,000.00	–0–
TOTAL EXPENSES	$21,203.18	$20,570.00	$ 633.18
NET INCOME FROM GUIDE	$ 1,469.30	$ 70.00	$ 1,539.30
DEFERRED OPERATIONS			
INCOME			
300—Guide advertising	$ –0–	$23,000.00	$23,000.00
EXPENSES			
PRODUCTION AND DISTRIBUTION			
305—Paper	$ 2,561.11	$ 4,000.00	$ 1,438.89
306—Printing and binding	–0–	14,000.00	14,000.00
307—Engraving and artwork	–0–	450.00	450.00
308—Editorial salaries	1,866.04	2,200.00	333.96
309—Distribution to members	–0–	2,000.00	2,000.00
ADVERTISING SALES PROMOTION			
315—Salaries and commissions	2,750.00	3,600.00	850.00
316—Traveling	806.57	1,200.00	393.43
EDITORIAL			
325—Guide committee expenses	332.36	350.00	17.64
TOTAL EXPENSES	$ 8,316.08	$27,800.00	$19,483.92

L. T. Avery, Cleveland, Ohio, Chairman of the Constitution and By-Laws Committee, was called upon to present the proposed amendments to the Regulations Governing the Committee on Research.

Amendments to the Regulations Governing the Committee on Research of the American Society of Heating and Ventilating Engineers

These amendments are submitted in accordance with the terms of Article B-1, Section 10.

ARTICLE I—Function

Section 1. The function of the Committee on Research is the determination and dissemination of knowledge pertaining to the arts and sciences of heating, ventilating and air conditioning, and the equipment and apparatus utilized by the profession.

Section 2. The purposes of the Committee on Research are: (*a*) to collect, tabulate, co-ordinate and determine by laboratory research, data pertaining to the arts and sciences of heating, ventilating and air conditioning; (*b*) to establish and maintain a Research Laboratory, and to make arrangements for cooperative research work with universities, colleges and other appropriate organizations.

ARTICLE II—Organization

Section 4. Research Finance Committee—The Chairman of the Committee on Research shall appoint for the ensuing year a Research Finance Committee of five (5) members of the Society and shall designate the Chairman. The Director of Research shall be an ex-officio member of this Committee.

Section 5. Director of Research—There shall be a Director of Research appointed by the Committee on Research subject to approval by the Council.

Section 7. Technical Advisory Committees—The Chairman of the Committee on Research shall appoint such Technical Advisory Committees and designate a Chairman of each, as may be deemed advisable, to act in an advisory capacity to the Com-

mittee on Research and the Director of Research for specific projects under consideration. At least one (1) member of each Technical Advisory Committee shall be a member of the Committee on Research. In addition the Director of Research and the Chairman of the Committee on Research shall be ex-officio members of all Technical Advisory Committees.

ARTICLE III—Duties of Officers

Section 1. Chairman—The Chairman of the Committee on Research shall preside at all meetings of the Committee and of the Research Executive Committee. He shall be an ex-officio member of the Council. He shall approve and sign all contracts made on behalf of the Committee on Research which, under the Constitution and By-Laws of the Society, require the signatures of the President and Secretary of the Society before becoming operative.

Section 2. Vice-Chairman—In the event that the Chairman of the Committee on Research is unavailable, the Vice-Chairman shall possess all the powers and perform all the duties of the Chairman.

Section 3. Director of Research—The Director of Research shall be responsible to the Committee on Research. He shall supervise all laboratory activities of the Society and shall have general charge of all research activities including the making of contracts for the rental or purchase of equipment or materials. He shall, under the authority of the Committee, select and engage, when necessary, a supervisor of the Research Laboratory and such research assistants and other personnel as may be required.

The Director of Research shall, subject to the approval of the Research Executive Committee, determine the order in which the subjects shall be investigated by the Research Laboratory.

The Director of Research shall prepare for the Research Executive Committee a budget of estimated income and expenditures of the Committee on Research for the next fiscal year.

All bills against Research which are covered by the budget shall, before being presented to the Secretary of the Society for payment, be approved by the Director of Research.

Section 4. Technical Adviser—The Technical Adviser shall be the consultant and adviser to the Committee on Research and the Director of Research on such matters as may be submitted to him by the Chairman of the Committee or the Director.

ARTICLE IV—Duties of Committees

Section 1. Committee on Research—The Committee shall establish and maintain a research laboratory, at a location and under conditions to be approved by the Council of the Society.

The Committee shall, subject to the approval of the Council, select and engage a Director of Research, and fix his compensation. The Committee shall establish a research program; shall approve a budget which shall govern expenditures for the fiscal year and shall approve all cooperative agreements.

Section 2. Research Executive Committee.

(b) The Research Executive Committee shall before November first of each year adopt a budget of estimated income and expenditures of the Committee on Research for the next fiscal year. Any proposed expenditure of Research funds outside of the approved budget shall be approved by the Executive Committee or, by delegation, by the Chairman of the Committee on Research, before the expenditure is made.

(c) The Research Executive Committee shall approve the compensation of all employees of the Committee on Research.

Section 3. Research Finance Committee—The Research Finance Committee shall with the cooperation of the Director of Research solicit the contribution of funds for the maintenance of Research activities. The Chairman shall report on the progress of the work at frequent intervals to the Chairman of the Committee on Research.

Section 4. Technical Advisory Committees—Technical Advisory Committees shall act in an advisory capacity to the Committee on Research and the Director of Research on all subjects referred to them. All Technical Advisory Committees shall be governed by the "Rules for Technical Advisory Committees" (Appendix A1).

ARTICLE V—Government

Section 5. Cooperative Agreements—At the discretion of the Committee on Research cooperative agreements may be entered into with universities, colleges or other appropriate organizations, for the investigation of any specific subjects on the research program. When such a cooperative agreement is to be consummated, the Research Executive Committee shall prepare a contract, stating the terms agreed upon. This contract shall be signed by the authorized representative of the college, university or organization, by the Chairman of the Committee on Research on behalf of the Committee, and by the President and Secretary of the Society, as required by Article B-VI, Sections 1 and 5 of the By-Laws of the Society.

Section 6. Headings of Papers—All papers, findings or reports resulting from the work of the Committee on Research shall, when published by the Society, be headed as follows:

(a) No change.

(b) No change.

(c) If the paper, finding, or report is the result of work at the Society's Research Laboratory, when located elsewhere than in *(a)* the following statement shall be used: "This paper is the result of research carried out by the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS at its Research Laboratory located at (address)."

Section 7. Payment of Bills—(a) All bills against Research activities shall be approved by the Director of Research, and he shall present approved bills to the Secretary of the Society. The Secretary shall check and, if correct, pay all items when covered by the budget, or emergency expenditures approved in writing by the Chairman of the Committee on Research. A summary of these accounts shall be made at least every month on a form approved by the Council. The Treasurer of the Society shall issue a check against the Research Fund, payable to the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, which check shall be deposited in the Secretary's special account. The Secretary shall draw against this amount in settlement of all approved expenditures.

ARTICLE VII—Technical Advisory Committees

Section 1. The Rules for Technical Advisory Committees may be amended at any regular meeting of the Committee on Research by a two-thirds vote of the members present, provided that any such amendment shall have been submitted in writing to each member of the Committee on Research at least two weeks before the meeting at which action is to be taken. Any such amendment shall become effective immediately upon its adoption by the Committee on Research and shall be published in the next issue of the JOURNAL.

Appendix A1

Rules for Technical Advisory Committees*

I. Organization of Committee

(1) Creation: The Chairman of the Committee on Research shall appoint such Technical Advisory Committees and designate a Chairman of each, as may be deemed advisable, to act in an advisory capacity to the Committee on Research and to the Director of Research for specific projects which are authorized.

(2) Scope: The Chairman of the Committee on Research shall furnish a brief statement covering the scope of activity for each Technical Advisory Committee at the time of appointment.

(3) Membership: The Chairman of each Technical Advisory Committee shall be a member of the Society and at least one member of the committee shall be a member of the Committee on Research. The Chairman of the Committee on Research and the Director of Research shall be ex-officio members of all Technical Advisory Committees.

Additional members may be appointed to an Advisory Committee at any time by the Chairman of the Committee on Research. The committee personnel shall be selected so that a majority are members of the Society.

The term of office of members of all appointed committees shall end at the close of each Annual Meeting and any member shall be eligible for re-appointment.

(4) Sub-Committees: The Advisory Committee shall decide what sub-committees shall be established and shall define the duties of each. Sub-committees shall work only upon such problems as are assigned to them or are authorized by the Advisory Committee.

II. Officers and Meetings

(1) Officers: The Chairman of each Technical Advisory Committee may appoint a Vice-Chairman and Secretary.

The Chairman, or in his absence the Vice-Chairman or designated member, shall preside at all meetings of the committee and shall be an ex-officio member of all sub-committees.

Minutes shall be kept of all committee meetings and copies shall be sent to the Chairman of the Committee on Research, the Director of Research and the Secretary of the Society.

(2) Meetings: Regular meetings of the committee should be held during the Annual and Semi-Annual meetings of the Society or special meetings may be called by the Chairman.

The meetings of any technical Advisory Committee shall be open only to the members of that Committee and to such visitors as may be approved by the Chairman.

A quorum for the transaction of business shall consist of a majority of the committee membership.

The date and place of all committee meetings shall be determined by the Chairman and written notices of all meetings shall be mailed to the members of the committee at least two weeks in advance of the meeting.

The Chairman of the Advisory Committee shall be notified in advance of all meetings of sub-committees and shall receive copies of minutes of these meetings.

III. Cooperation with Other Organizations

(1) Method of Initiating Cooperation: An Advisory Committee desiring to cooperate with representatives of other organizations or desiring to invite the cooperation of other organizations in the work being done, shall address a recommendation to that effect to the Research Executive Committee and, if approval is given, negotiations to the desired end shall be conducted by the Chairman of the Committee on Research.

IV. Expenses

(1) Current Expenses: Expenses for postage incurred in connection with the business of committees shall be refunded by the Society on presentation of vouchers approved by the Chairman.

(2) Stationery: Correspondence relating to the business of committees shall be conducted on official stationery of the Society which will be furnished upon request.

(3) Extraordinary Expenses: Items of expense other than postage will not be assumed by the Society, unless such expenditures were incurred in pursuance of previous authorization by the

*Adopted by Committee on Research, January 30, 1944.

Committee on Research and within the limits specifically fixed by the Committee on Research.

(4) Special Funds: Advisory Committees may be authorized by the Research Executive Committee to solicit contributions to be earmarked for research on specific projects approved by the Committee on Research. All funds thus collected shall be transmitted to the Secretary of the Society and deposited in the Research Fund subject to disbursement only on voucher approved by the Director of Research.

(5) Salaries and Fees: Committees are not authorized to pay salaries or professional fees in any form to any of their officers or members.

V. Directions for Conduct of Work

(1) The Committee shall first review all previous work done on the subject assigned to them for study and prepare a bibliography.

(2) It shall outline a comprehensive program of research and indicate fields in which most productive work should be done.

(3) It shall select research most suitable for Advisory Committee activity and decide what phases of the program require laboratory investigation.

(4) It may consult the Technical Advisor to the Committee on Research for advice concerning any phase of its projected or approved research program.

(5) The Committee shall survey available laboratory facilities and recommend to the chairman of the Committee on Research those places which are best equipped with apparatus and personnel to undertake the desired research.

(6) The Committee shall, with the cooperation of the Director of Research, prepare a statement of the scope of the investigation and this, together with an outline of the method of procedure to be followed and an estimate of the cost of the work, shall be transmitted to the Chairman of the Committee on Research for approval.

(7) When a project has been approved, the Chairman of the Technical Advisory Committee shall share with the Chairman of the Committee on Research and the Director of Research the responsibility for supervision of the work.

(8) Laboratory investigations may be conducted:

(a) At the Society's Laboratory with general funds appropriated by the Committee on Research or earmarked funds specifically collected for particular projects.

(b) Through a Cooperative Agreement with an institution approved by the Committee on Research with general funds appropriated by the Committee on Research or earmarked funds specifically collected for particular projects.

(9) All sponsored or supervised research planned by an Advisory Committee must be designed to develop fundamental principles and/or test methods and, in the publication of the results by the Society or with the approval of the Society, no specific commercial product shall be identified.

(10) An Advisory Committee is not empowered to draft Society codes but it may draft regulations for a testing procedure for Committee use.

(11) During the progress of any investigation the Advisory Committee Chairman shall assist the Chairman of the Committee on Research in disseminating through the headquarters office of the Society, proper publicity regarding the projects.

(12) Each Advisory Committee shall review each year those sections of The Guide which pertain to its scope of activity and submit its recommendations in writing to the Guide Publication Committee.

(13) Each Advisory Committee shall submit an annual report in writing to the Chairman of the Committee on Research, not later than December first of each year, covering the work of the committee during the year with recommendations for future activity.

VI. Submittal of Research Papers

(1) When Laboratory work has been completed and a report prepared covering the work or any other report is completed covering a phase of the Committee's activities, a copy of the manuscript, together with a ballot blank, shall be sent to each member of the Advisory Committee not less than 60 days prior to publication or meeting presentation date, whichever is the earlier.

(2) Committee members shall be requested to review the paper or report and return a ballot to the Chairman within 10 days.

(3) Within a period of 10 days the Chairman of the Advisory Committee may obtain necessary revisions to the manuscript based on the comments received from Committee members and resubmit the manuscript for final Committee approval.

(4) If two-thirds of the voting Committee members approve the paper it shall be recommended to the Director of Research and Chairman of the Committee on Research for publication.

(5) Manuscripts approved for publication by the Chairman of the Committee on Research shall be transmitted to the Secretary of the Society not less than 30 days prior to publication and submitted in the form outlined in SUGGESTIONS FOR AUTHORS adopted by the Society.

(6) Research papers are subject to final approval for publication as per Article R-XII of the RULES of the Society.

VII. Reproduction of Research Data

General

It is the intention of the Committee on Research that all reports covering investigations at the Research Laboratory and in cooperative institutions receive the widest dissemination possible. However, in the interests of everyone concerned it is important that these research data be used in proper form so that the facts may not be distorted. It is for this reason that these rules have been prepared covering the reproduction of Society research data.

Publications

(1) Any publication wishing to reprint a research report in part or in full must first obtain permission from the Society in writing. After permission is obtained, the material to be reproduced must be submitted for final approval to the Secretary of the Society at least 10 days in advance of publication and must contain the authorized credit reference to the authors and the Society.

Reprints

(2) Reprints of any research report may be obtained by application to the Society within a reasonable time after publication and upon payment of charges established by the Council, for distribution in such form by any individual, company or trade association.

Handbooks, Textbooks or Company Manuals or Promotional Trade Literature

(3) Data, charts, or quoted text, including discussion of same, from any research report; or any data, charts, or quoted text included in the Guide which has been prepared from any research report; may be reprinted in any handbook, text book or company or trade association engineering manual or promotional trade literature with the authorized credit reference to the original source of publication, after permission for such reproduction is obtained from the Society in writing.

Advertisement

(4) The use of any data, charts, or quoted text from any research report or the Guide for display advertising purposes in any magazine or other paid advertisement cannot be permitted.

W. L. Fleisher, New York, N. Y., in discussing the proposed amendments stated that in order to keep a contact between the Committee on Research and the Council, the Society adopted an amendment several years ago making the Chairman of the Committee on Research Ex-Officio, a member of the Council. He mentioned that whereas it had been unheard of that the Committee on Research and the Council should be interlocking, there were now 6 Council members on the Committee on Research. The Society should have enough capable members, he said, to fill the positions on both the Committee on Research and the Council without need for duplication. In his opinion it was the intent of the Society that the only representative on the Council from the Committee on Research should be its chairman. In order to maintain independence of the Committee on Research he suggested an amendment to the By-Laws somewhat as follows:

No member shall be eligible to run for two elective offices at any one election.

President Blankin stated that the change proposed by Mr. Fleisher would necessitate a change in the By-Laws.

Mr. Avery said that the change proposed by Mr. Fleisher would prevent a member from running for office while holding another office. Careful consideration should, therefore, be given to all possible effects of the proposed change. It seemed possible, however, to obtain an informal opinion from the members present at this meeting.

Mr. Fleisher suggested that with such a large attendance it would be a good time to bring the matter to the Society's attention and he stated that an expression from those who had served on both the Council and the Committee on Research would be desirable.

President Blankin stated that, as Mr. Avery had indicated, the amendments to the Regulations Governing the Committee on Research were recommended for adoption by unanimous action of the Committee on Research.

On motion by L. T. Avery, seconded by W. A. Russell, it was

VOTED that the amendments to the Regulations Governing the Committee on Research be approved.

On motion by W. L. Fleisher, seconded by F. W. Legler, Minneapolis, it was

VOTED that the Committee on Constitution and By-Laws consider necessary changes in the Constitution and By-Laws and Rules of the Society which would prevent duplication of members on the Council and the Committee on Research.

President Blankin turned the meeting over to First Vice-Pres. S. H. Downs, Kalamazoo, Mich., who called upon John Howatt, Chicago, Ill., to read the paper, Fifty Years in Heating and Ventilating, by S. R. Lewis (published in January 1944, Journal Section, Heating, Piping & Air Conditioning).

Vice-President Downs then presented Lieut.-Comdr. F. C. Houghten, who gave an abstract of his paper, Progress in

W. H. Driscoll
Syracuse, N. Y.

B. M. Woods
Berkeley, Calif.

T. H. Urdahl
Washington, D. C.

the Development of Standards for Comfort Air Conditioning (published in this issue, see p. 170).

Panel Discussion

Vice-President Downs then called upon Dr. B. M. Woods, Berkeley, Calif., to conduct the Panel Discussion on the subject of Future Trends of Heating, Ventilating and Air Conditioning.

Chairman Woods called the roll of panel members as follows: D. M. DeBard, War Production Board, Washington, D. C.; W. H. Driscoll, Syracuse, N. Y.; L. T. Mart, Kansas City, Mo.; Comdr. T. H. Urdahl, Washington, D. C.; and C. E. Lewis, Rochester, N. Y.

Chairman Woods presented the plan which was to have a member of the panel introduce each of the subjects, ventilation, heating, cooling and physiological effects. He stated that a fifth item, war conditions and conservation would be discussed separately.

Ventilation

Mr. Driscoll traced the history of ventilation and pointed out that for 100 years it was believed that CO_2 was the poisonous element in air. This error was originally presented in Lavoisier's Theory in the year 1775. In 1853, or thereabouts, Pettenkofer stated that CO_2 was not a poisonous element of the air, but that it was the best index to the poison that might be present in the atmosphere. Emphasis was placed on quantity of air rather than on quality and the objective of ventilation for a long period was to obtain an inside air condition equivalent to that found outside. Little attention was paid to any items besides quantity of air until the New York State Commission on Ventilation presented its 1923 report. Mr. Driscoll then referred to the ASHVE meeting in Buffalo, N. Y., in 1925, at which Dr. C.-E. A. Winslow presented the conclusions of the Commission and took part in the discussion which followed. The Commission's report served to point out some fallacies that existed in ventilation practice at the time. In the early years of the Society it had a Committee on Compulsory Ventilation which had the objective of influencing the legislatures of states in the preparation of statutes specifying definite quantities of air for ventilation. The advent of air conditioning removed the emphasis from air quantity and focused it on quality and lead to the observation that, excepting for removal of odor, quantity of air could almost be ignored because under ordinary conditions of human occupancy, no amount of carbon dioxide or toxic material would accumulate to the extent that it would be dangerous to human health.

Mr. Lewis stated that in the post war period with new types of building construction as well as with fully enclosed spaces, the problems of ventilation would be greater than ever before.

C. E. Lewis
Rochester, N. Y.

L. T. Mart
Kansas City, Mo.

Chairman Woods asked whether ventilation in the transportation industry was making satisfactory progress.

Mr. Driscoll stated that transportation air conditioning had progressed so that no one would want to be without it in railroad cars, airplanes, and buses.

Mr. Lewis stated that there was room for great improvement in air conditioning of airplanes. A lot of attention is being paid also to air conditioning in the bus transportation field.

Mr. Driscoll recalled that at high altitudes the question of quality of air was not in question, but that quantity was.

Chairman Woods asked what the ventilation situation was in the present home.

Mr. Fleisher stated that the most active problem, and one which is farther from being solved than any other, is that of home ventilation. Cleaning has been the paramount issue in homes, but the subject of proper humidification is far from settled. He mentioned that Dr. E. E. DuBois, Cornell Medical College, New York, N. Y., and Prof. C. P. Yaglou, Cambridge, Mass., had come to the conclusion that humidity in the home was not essential because it did not produce any physiological changes in the occupants.

Mr. Fleisher believed, however, that the discomfort resulting from humidity below 25 or 28 per cent was a good measure of the physiological and sensatory reactions of the individual.

Mr. Driscoll remarked that much fuel would be saved today if people were not fresh air fiends who needed to have the bedrooms down to zero, with windows wide open no matter what the outside temperature might be. He stated that infiltration is quite sufficient to maintain proper quality conditions in the home. He further stated that infiltration, especially on the windward side of a house, might readily supply all ventilation necessary to bedrooms.

Mr. Howatt emphasized the importance of approaching fuel conservation from all angles and paying attention to every item which might be effective in saving heat.

Heating

Chairman Woods asked Mr. Lewis to develop the subject of heating.

Mr. Lewis stated that great interest is centered today in the small home which according to census figures of 1920, 1930 and 1940, has fewer occupants today, per home, than formerly. In 1920 there were 5.2 occupants, per home, whereas in the last census this figure had decreased to 3.8. There has been a decrease in size of homes, as well as a decrease in occupancy. He mentioned the estimate of 1,200,000 homes to be built, per year, during the first five years after the war. It was assumed that 60 per cent of these new homes were going to be of four or five rooms, at a value of $4000 and that 35 per cent would be in the group having a value of $5000 to $10,000, which would provide six or seven rooms. Only 5 per cent, it is assumed, would have a valuation in excess of $10,000. Insulation, storm sash, and weatherstripping would be insisted upon by owners of new homes. Heating plants for homes would require Btu outputs of only 30,000 to 50,000 per five-room home, or 40,000 to 70,000 for six- and seven-room homes. The trend toward smaller sizes of heating units makes it necessary for the manufacturers of heating equipment to develop appliances having the required low capacities. He suggested that the heating plant for the new home should be fully automatic and have efficiencies reaching 70 to 85 per cent. Automatic equipment, which had been largely gas- or oil-fired, needed to be developed considerably to make coal a more acceptable fuel. He also stated that from an investigation made it was his opinion that there would be no problem in securing sufficient oil fuel for home heating after the war.

R. K. Thulman, Washington, D. C., expressed the opinion that 95 per cent of the houses to be built after the war

would require heating plants having a capacity not in excess of 50,000 Btu per hour. He thought that Mr. Lewis had made a mistake in saying that oil was the number one fuel.

Mr. Lewis stated that the total distribution of automatically fired equipment was divided as follows: 2,600,000 oil-fired; 1,038,000 gas-fired; and 850,000 stokers. He also remarked that there were 26,000,000 wood-heated homes.

Mr. Thulman offered a correction by stating that there were 35,000,000 wood-heated homes. A further suggestion by Mr. Thulman was that instead of attaching a domestic hot water heater to the heating system it would be possible in future homes, which will have a small heat loss, to build a good hot water heater and then attach the heating system to it.

F. W. Legler, Minneapolis, Minn., remarked that he had experienced difficulty with well insulated, weatherstripped homes in the Northwest, where there was an excess of humidity, particularly in those having gas-fired heating plants. He estimated that in the future 5 to 7 per cent of the cost of a home would be available for purpose of a heating plant.

E. H. Lloyd, Washington, D. C., stated that in his experiences with several hundred gas-fired installations in Washington homes, he found that over-humidification occurred in well-insulated homes because of moisture produced in cooking, etc., and that it was not due to the use of gas-fired heating appliances. He believed it would be necessary to educate people to use vapor barriers and to reduce the amount of humidity produced within smaller homes.

E. Holt Gurney, Toronto, Canada, remarked that he had changed his mind regarding the percentage of post war homes which would be small and felt that there was a possibility that homes of four or five rooms were going to be too small for the average size family.

F. E. Giesecke, College Station, Tex., stated that in the gas-heated homes mentioned by Mr. Legler the humidity could not have been caused by the gas appliances if they were vented.

T. D. Stafford, Grand Rapids, Mich., mentioned two installations in which the humidifiers had never been used because the humidity was never below 30 per cent. The homes were insulated and were supplied with a double layer of vapor seal paper on the inside of the insulation. Adequate humidity was provided by the normal cooking and washing operations within the home.

Mr. Miller, Columbus, Ohio, stated that whereas complaints of insufficient humidity were common ten years ago, he has found that in present insulated homes it is more common to experience complaints of excess humidity.

R. A. Wasson, New York, N. Y., made the comment that excess humidity could be reduced by an increase of ventilation.

W. F. Ryan, Salina, Kans., remarked that in the solution to the excess humidity problem in forced air installations was to take in an increasing quantity of fresh air.

Mr. Lewis, in referring to a remark made by Mr. Gurney, stated that the tendency toward small families actually did exist and that any change in this tendency would not be effective until about 20 years after the war. It was, therefore, his opinion that the trend in size of homes to be constructed would be downward during the next 5 to 10-year period.

Cooling

Chairman Woods then called upon L. T. Mart, Kansas City, Mo., to introduce the subject of cooling.

Mr. Mart reviewed some of the steps in the development of cooling towers.

Chairman Woods asked the members of the panel whether in the home of the future the so-called package unit might receive more favor than the central unit for room cooling.

Mr. Lewis expressed the belief that the individual room-cooling units would present opportunities, particularly if they could be reduced in size, made foolproof in operation, and attractive in cost.

Chairman Woods asked T. H. Urdahl to discuss the possibility that in the future the reaction of the individual would be given more consideration than heretofore in designing the equipment for keeping him comfortable.

Commander Urdahl pointed out that the time has come when many things, including heating systems, must be analyzed in a different light than heretofore and that greater attention must be paid to the requirements of the individual. While the human being seems to be able to perform all manner of tasks under extremely adverse conditions and in extreme temperatures it is, nevertheless, true that efficiency cannot be obtained under extreme conditions and that, consequently, in the future environmental conditions should be considered in order to enable the individual to operate with great efficiency.

Chairman Woods asked D. M. DeBard, War Production Board, Washington, D. C., to speak upon the problem of coal and fuel conservation.

Mr. DeBard called attention to the need for cooperation in conserving fuel in industrial plants. He suggested, (1)

Past Presidents' Dinner, January 31

(From left to right around table): John Howatt, F. B. Rowley, H. M. Hart, G. L. Larson, W. T. Jones, Thornton Lewis, H. P. Gant, W. H. Carrier, W. H. Driscoll, C. V. Haynes, E. Holt Gurney, J. F. McIntire, W. L. Fleisher, E. O. Eastwood, S. E. Dibble, F. E. Giesecke.

that attention be paid to improvement of over-all efficiency and operation of heating plants, (2) reduction of air supply to the minimum requirement by health limitations, and (3) utilization of exhaust steam from process work for heating purposes wherever possible. He cited a number of installations in which savings had been made by improvement in operation, by a reduction of the quantity of air exhausted and by recovery of heat from industrial processes. He mentioned that it was the intention of the Government to make a critical examination of a number of the 1700 Government-owned defense plants in order to determine whether fuel savings could be made. In each plant examined the following items would be listed: (1) average quantity and temperature of air exhausted per minute from October 1 to April 1; (2) average quantity and temperature of air per minute introduced into the plant from October 1 to April 1; (3) quantity of exhaust steam discharged to the atmosphere; (4) square feet of floor space and temperature maintained; and (5) the disposition of the condensate.

Mr. DeBard appealed to the members of the Society to submit recommendations and suggestions for ways and means of saving fuel and gave his assurance that the Conservation Division of WPB will be pleased to have the assistance of the Society in any efforts that might be made.

Chairman Woods expressed his thanks to the members of the panel and to those who aided in the discussion. He then turned the meeting back to Vice-President Downs, who expressed his appreciation to John Howatt, who presented the paper by S. R. Lewis, and to Commander Houghten for his presentation.

Third Session—Tuesday, February 1, 9:30 A. M.

The third session was called to order at 9:30 a. m. by President Blankin in the Georgian Room, and Second Vice-Pres. C.-E. A. Winslow, New Haven, Conn., then took the chair.

F. E. Giesecke, College Station, Tex., presented an abstract of his paper, A Study of Intermittent Heating of Churches (published in December 1943, Journal Section, Heating, Piping & Air Conditioning).

E. K. Campbell, Kansas City, Mo. (Written): Dr. Giesecke's continued interest in the matter of the intermittent heating load for churches and other intermittently heated buildings has been of much comfort to me in view of the fact that through a number of years I have been unable to interest the Society in that particular subject. I hope the two presentations he has made will increase the interest and bring a realization that the Society is overlooking the lack of knowledge in this particular field, and the consequent large number of poorly heated churches and other buildings which are not heated continuously.

Our Society is very proud of its original research, the original studies of problems where information was lacking, and the results we have been able to show. Here is another opportunity.

Many years ago, in designing church heating systems, I realized that this was a vital problem. There were neither the equipment, the time nor the mathematical facilities to go into this problem scientifically. We did reach the conclusion after much study that the heat absorbed by the cold material was the determining factor, and that any calculation must be based on the maximum, combined heat flow into the cold material and out of the building in the normal manner. We recognized that there would be a changing ratio and that at some point in the heating-up period, there would be a maximum combined figure that would determine the minimum capacity of the heating plant required to satisfactorily heat a cold building in a given length of time. As Dr. Giesecke has pointed out, the load depends not on the entire amount of heat absorbed by the cold material in the heating-up process, but on the *maximum amount absorbed and transmitted* at any one time within that period.

If at that time the heating plant has the capacity to supply all of the heat which is being absorbed by the cold material plus all the heat which is being transmitted to the outside in the normal way, and then some additional capacity, the heating-up curve will continue to rise. If it lacks that capacity, it will reach a point where the curve will level off and the inside temperature cease to rise. The length of time the curve remains flat will be determined by the extent of the shortage in capacity. If the capacity is based on normal heat loss alone and the weather severe, the curve might remain flat for days. If the shortage is not severe in proportion to the weather, the flat portion of the curve will be short—as the temperature of the material rises and its heat absorption becomes less, there will again be heat available to begin to raise the inside temperature. This additional capacity, to heat the cold material and still keep the inside temperature rising, spells the difference between a successful and an unsuccessful plant.

An analysis of the figures shows, that the maximum amount of heat required came about the seventh of the nine periods. From then on, the amount of heat absorbed decreased and the amount of heat transmitted to the outside increased, but the total decreased. Equilibrium was being approached, but it would take some hours yet to reach a period of equilibrium when the normal heat loss of the building would be all that would be required from the heating plant.

Another feature of importance is the radiant cooling effect if the surrounding material is not warmed and consequently receives radiant heat from the person without radiating back. It would, of course, not be possible to heat the air without putting some heat into the material, but if the air temperature is brought up rapidly, the material will be heated much more slowly so that this radiant cooling effect will prevail. Hence, comfort cannot be established until the surface temperature of the cold material is raised to such a value that its absorption is not so rapid nor so great.

The control of the heat input is also highly important if overheating is to be prevented. Sufficient direct radiation to meet the maximum heating-up load would cause great overheating at all other times. It would seem, therefore, that a remote controllable source of heat should be used, with 100 per cent recirculation during the heating-up period and with ability to bring in, when needed, large volumes of outside air for temperature control and ventilation.

The case considered has rather more than the average heat absorption capacity in that the outside brick walls were 21 in. thick and the floor was a concrete slab 7.2 in. thick. The center of the material shows a very slow rise in temperature which required long hours of firing before equilibrium could be reached.

Dr. Giesecke's method of dividing the time into nine periods greatly aids the solution of the problem. I believe he has presented and worked out the basis for the involved and multitudinous calculations necessary to put this information in final form from which the maximum heating-up load of a cold building can be determined in advance. This information to be useful must be in such form that it is easily applied.

The percentage of 173 which Dr. Giesecke has arrived at compares very closely to the percentages which we have arrived at purely out of our experience. If fireproof interior construction and many partitions and possibly a concrete roof were added to this particular church, we would normally increase the excess capacity of the plant to 100 per cent.

Where there is no interior concrete slab and the exterior walls are not quite so heavy, we lower the percentage perhaps to 50.

Therefore, all the experience we have had would indicate that Dr. Giesecke's method is arriving at a very accurate practical result, and if the work can be carried on to a logical conclusion and the data put in shape for convenient use by those designing church heating systems, the Society will have rendered another great service.

As it should not be too expensive to follow up Dr. Giesecke's method, I hope very much that the Committee on Research will see fit to take up this subject for further development at an early date.

E. G. Smith, College Station, Tex. (Written): This paper has made an important contribution to the art of intermittent heating because the authors have called attention to the fact that during unusually cold periods, the interior portions of an exterior wall are practically certain to be at a temperature somewhere near the temperature of the air in the interior of the building itself. This has a very direct bearing on the computation of intermittent heating loads by the absorbance method described by the writer in a previous paper.[1] As described in the above paper and also more fully in Bulletin No. 62 of the Texas Engineering Experiment Station, the heat requirements for an intermittently heated building come out too high. It was already known that the surface coefficients used were too high for

[1] A Method of Compiling Tables for Intermittent Heating, by Elmer G. Smith (ASHVE Journal Section, Heating, Piping & Air Conditioning, June 1942, p. 386).

the transient conditions that exist during the period of rising air temperature. Dr. Giesecke and Mr. Campbell have made it clear that the *steady state* load will certainly be negligible and may even be negative. As a result, the *steady state* part of the load can be omitted entirely. This makes the computation of an intermittent load for a given wall just as simple as the computation of the *steady state* load for the same wall. The only difference is that a table of absorbances, instead of a table of conductances, must be used.

Dr. Giesecke has suggested that the writer make absorbance computations on the church described by him and Mr. Campbell. This will gladly be done as soon as time can be found to put the results into readable form.

W. H. Carrier, Syracuse, N. Y., stated it is customary to allow about 50 per cent excess heating capacity for intermittently heated or cooled buildings. When the desired optimum temperature is reached there will remain a 50 per cent excess capacity. The heating-up problem can be approached in two ways: (1) a certain excess capacity can be provided and from it the time required can be determined, or (2) the time required can be assumed and the needed excess capacity can be computed from it. If a building is to be heated in two hours the excess capacity required may be 100 per cent. If the same building can be heated up in 4 or 5 hours the excess capacity required may be only 50 per cent. The fuel required may be the same in both cases. A similar problem occurs in cooling mines which have an infinite wall thickness. The wall is circular instead of flat and is of infinite thickness. In cooling mines the original rock temperature may be 140 deg. As no one can work in a temperature of 140 deg, air blast is directed upon the workers while driving tunnels through the rock. The cooling of the rock by the air passing through a tunnel is an application of Dr. Giesecke's principle, although more difficult to determine because of radial flow. In a 13-in. brick wall the time required for the peak of the heat wave to travel through the wall will be 13 or 14 hours. If the wall is 6 or 6½ in. thick the time required will be reduced to one-fourth, because the law of squares applies. Suppose the walls were of brick and were 12 in. thick and an ample heating capacity were provided to hold a uniform inside temperature. It would then take over half a day to reach a steady state. It would take longer under actual conditions because the air temperature could not be immediately raised to 70 deg.

W. A. Danielson, Memphis, Tenn., remarked that when a furnace is being heated and is fired correctly a fairly steady Btu output is obtained. What becomes of the Btu's which represent the difference between the output of the furnace and the heat absorbed by the air?

L. T. Avery, Cleveland, Ohio, stated that the heating problem in churches was a most difficult one. Cold walls cause people who sit near them to be uncomfortable and the engineer has a difficult time trying to determine how to increase the temperature of the wall surface.

H. M. Hart, Chicago, Ill., remarked that he was particularly interested in observing when the outside wall temperature reached a point at which the people sitting near to them could be comfortable, because wall temperature is important in determining comfort in churches. The difficulty of heating churches is due not only to intermittent heating, but to the use of high ceilings and a large amount of glass surface, which is a cause of down draft. Due to the massive wall structure it is not unreasonable to start heating of churches at least 10 hours before occupancy, and even this length of time may not be sufficient to obtain the proper wall temperature even though the excess heating capacity is about 50 per cent. A very expensive heating installation would be required to heat a church structure as much as 40 deg in 2 hours and such a large installation would be difficult to control after the heating-up period, particularly in mild weather.

R. G. Vanderweil, Waterbury, Conn., pointed out that by use of radiant heating it might not be necessary to heat the entire wall surface of the structure, but that comfort might be obtained by proper distribution of radiant panels.

Dr. Giesecke, in referring to Dr. Carrier's remarks stated that it was possible to either select the time required for the heating period and determine the excess capacity of the plant or assume the excess capacity and find the time required, but that in doing so the wall surface temperature must be taken into account. In answer to W. A. Danielson's question, he stated that he did not know what became of the unaccounted for heat. If the furnace delivers heat at a uniform rate, then air temperatures must be considerably higher than have been assumed.

W. A. Danielson remarked that there probably was considerable stratification of air such as had been found in airplane hangars, with the result that the air temperature near the ceiling would be considerably higher than shown, and consequently, more heat had been absorbed by the air than had been assumed. The higher air temperature near the ceiling would also increase the transmitted heat loss in that part of the structure.

Mr. Campbell stated that in heating buildings having high ceilings it is necessary to handle large volumes of air at a lower temperature in order to avoid high air temperatures at the ceiling. He mentioned one case in which the cubical contents were so great in proportion to the heat loss that the quantity of air handled was such that a 25 deg temperature rise through the furnace was obtained and the air temperature variation in a height of 90 ft was 12 deg. It is the air movement and not the heat capacity of the furnace which is important because the output of the furnace is adjusted to obtain the heat required.

Author's Closure: It will be apparent from the fact that when the air temperature has reached 70 deg at the end of the 3-hour period, the wall surface temperature is only about 51 deg. The mean radiant temperature near the floor must be even below 50 deg because the window temperature is less than 50 deg. A 50-deg mean radiant temperature and a 70-deg air temperature would not produce comfortable conditions in persons normally clothed. As stated by Mr. Vanderweil, the use of radiant heating-up to a wainscot height would readily produce a comfortable condition. A church in England in which the heating system when operated intermittently was so unsatisfactory that the church was practically abandoned, was satisfactorily heated by adopting continuous operation of the heating system.

Chairman Winslow then called for the second paper, The Resistance to Heat Flow Through Finned Tubing, by W. H. Carrier and S. W. Anderson (to be published with discussion in a later issue of the Journal Section, Heating, Piping & Air Conditioning).

Mr. Anderson presented an abstract of the paper, and a discussion followed in which the following took part: H. B. Nottage, E. Hartford, Conn., G. L. Tuve, Cleveland, Ohio, and William Goodman, La Crosse, Wis.

Chairman Winslow introduced Professor Tuve who presented an abstract of the paper, Control of Air-Streams in Large Spaces, by G. L. Tuve and G. B. Priester (published in January 1944, Journal Section, Heating, Piping & Air Conditioning).

C. M. Ashley, Syracuse, N. Y. (Written): Considering outlets in the form of orifices, there is a physical reduction of the size of the stream, but as a matter of fact almost all of the energy available in the form of *static pressure* ahead of the outlet is effective at the discharge. Therefore, I believe that the proper procedure for this type of outlet is to figure the area from the *available static pressure ahead of the outlet*, or from the *total pressure* at the outlets, and the cfm of air, and otherwise to treat the outlet as a nozzle of dimensions smaller than the physical size of the outlet. On the other hand, where bars, grilles, or other similar obstructions are introduced into the outlet, the effect is quite different because the air stream is discharged substantially over the whole face of the outlet and becomes fairly uniform in velocity a few inches or even 1 or 2 inches from the outlet. There is, with this type of outlet, an appreciable loss of available energy, and consequent reduction in velocity due to the conversion from the area of the individual streams to the area of the stream as a whole.

What actually happens, I believe, is that the velocity through the outlet is considerably higher than that equivalent to the static pressure behind the outlet, and that a certain portion of this is converted into pressure directly in front of the outlet. I believe you will find that an appreciable negative pressure is obtained in the streams in front of the outlet and that this pressure is rapidly reduced as the streams converge. However, this conversion process is carried on with considerably less than 100 per cent efficiency so that the resulting final velocity is less than that equivalent to the static pressure behind the outlet. In practice, for an outlet of this sort, I would recommend that the discharge area be based upon the cubic feet of air per minute divided by the measured outlet velocity and that the static pressure be determined independently and applied as an efficiency factor or coefficient of resistance. Alterna-

tively the area of the stream can be measured and the velocity calculated. I believe this problem should be explored further in your continuing program.

Authors' Closure: Very little has been done in investigating the bar type grilles mentioned by Mr. Ashley, because it seemed desirable to use simple type grilles at first. The results reported in this paper are concerned mainly with that portion of the airstream which is at a distance of several diameters from the outlet.

Mr. Priester then cited several examples to show how the data presented in the paper could be used to solve various types of problems involving the maximum velocity or the distance at which a given velocity would exist.

Chairman Winslow made the closing remark that many of the difficulties mentioned in the papers presented by Dr. Giesecke and Professor Tuve would be non-existent if buildings were heated by radiant heat rather than by convection heating. He then thanked the various authors and those who took part in the discussions, whereupon the meeting adjourned at 12:30 p. m.

Fourth Session—Tuesday, February 1, 2:00 P. M.

Vice-Pres. S. H. Downs called the meeting to order at 2:00 p. m. and presented Prof. F. B. Rowley, who gave an abstract of his paper, Discoloration Methods of Rating Air Filters, by F. B. Rowley and R. C. Jordan (published in September 1943, Journal Section, Heating, Piping & Air Conditioning).

G. W. Penney, East Pittsburgh, Pa. (Written): I think that it is important to look into all means of measuring efficiency of air cleaning devices. This paper confirms my opinion that the discoloration test substantially as described by Mr. Dill in 1938 and referred to by Professor Rowley as a *matching efficiency* is the most useful test that has been proposed.

The information which I would like about any air cleaning device would consist of a determination of efficiency as a function of both particle size and type of material to be removed. I believe that such a test is obviously impractical for anything except a very extensive research on a particular device. I believe that no simple test can measure adequately all of the functions needed in an air cleaning device. We must then choose a test that comes the nearest to measuring the desired factors and is sufficiently simple to conduct. The discoloration test proposed by Mr. Dill measures the relative time required to produce a given discoloration which, I believe, is the factor of greatest interest in most applications.

The *psychological efficiency* as described in this paper has several objections. It is supposed to give the relative soiling as estimated by the eye after a given period of operation with and without an air cleaning device. However, in practice we do not want to clean walls, draperies, etc., at definite periods when we install an air cleaning device. We are instead more interested in lengthening the periods between cleanings. If I interpret the paper correctly, it seems to me that the efficiencies given do not correctly interpret the values given for the response of the eye in Fig. 1. The tests given use only a partially blackened sample, and yet it is applied to the curve of Fig. 1 as though this sample were entirely black. This exaggerates the discrepancy between the various methods of measuring efficiency. The exact definitions of efficiency and methods of calculating efficiency are hard to follow as given in the paper, and I believe it would help if in the discussion the authors would give sample calculations.

In conclusion, this examination of various methods of measuring efficiencies has served to confirm my opinion that the method substantially as given by Mr. Dill is the most satisfactory method of determining a discoloration efficiency since it is simple and closely approximates the factor in which we are usually most interested.

R. S. Dill, Washington, D. C. (Written): This paper is regarded as a useful addition to our fund of knowledge since it is evident that the test method and the optical concepts described have received consideration and trial. However, the paper and its results are not expected to materially influence air filter testing because simpler effective test methods are known and because it is doubtful whether many people will accept the theory that air cleaner effectiveness can be based on ability to reduce visual discoloration in the manner described. No relation has been established between the ability of an air cleaner to prevent discoloration of a filter paper through which a portion of its effluent air has been drawn and the ability of the cleaner to prevent dirtiness in a room ventilated with air from it. Presumably, acceptable criteria at present, so far as effectiveness is concerned, are that the filter is best (1) which will arrest most dust of a given size or (2) which will arrest the finer dust.

Air cleaner tests with filter paper and reflected light were tried at the National Bureau of Standards in 1934 and 1935 for the reason that photometers suitable for this purpose were conveniently available. Such tests were abandoned in favor of transmitted-light tests for the reason that results were easier to reproduce with transmitted light. When transmitted light is used, the effect obtained is largely independent of dust color. When the deposit density is not too great, each dust particle interrupts its own fraction of the light and hence registers its proportionate effect.

It is unfortunate that the paper under consideration does not give information on reproducibility of results. It would be interesting to know whether the data presented are average and whether or not it was necessary to apply the method of least squares in order to arrive at the figures shown. Of these figures, those in Table 2 for the Weight Test Method and for the Transmitted-Light Test Method are considered to be of most interest. The great difference in the efficiencies indicated by the two methods is noted and we surmise that it is attributable to the great size range of the test dusts used. In the test dust there were probably a few large particles which the filters were very effective in arresting, which accounts for the high efficiency by the weight method, while there probably were many small particles, which the filters were not so effective in arresting, which accounts for the comparatively low efficiency by the transmitted-light method. For an absolutely homogeneous dust, if such were attainable, efficiencies by the two methods would be expected to coincide, within the experimental error. The desirability of a dust of small size range is considered to be indicated for efficiency tests.

Nothing is said in this paper about filter paper selection. At the National Bureau of Standards, it has been found necessary to use pairs of filter papers for each test which are optically matched before use. Otherwise, acceptable reproducibility of results is not achieved. Such matching is necessary even though filter papers are cut for use from the same sheet.

No sufficient reason has appeared for not using a sampling tube both upstream and downstream of a filter under test. This method is applicable to tests of electrostatic equipment with air-borne dust as well as to other cleaners with dust injected into the air. The method utilizes the photometer as a "null" instrument and assumptions about the relation between efficiency and transmittance or between efficiency and reflectance are avoided.

It is probable that continued research on test dusts, on the dust holding capacity of filters and on the actual effectiveness of air cleaners in keeping houses cleaner and more healthful is in order. I, for one, would be content to let the so-called blackness or discoloration test remain substantially as it has been developed and is now in use.

J. W. May, St. Matthews, Ky. (Written): The authors should be commended for their new and interesting approach to the problem of discoloration methods of rating air filters. The general subject of discoloration efficiency has many ramifications and a paper of this nature not only adds to the collective knowledge of the subject but it stimulates interest and thought in a field which has been somewhat neglected in the past.

In reviewing the present photometric method for rating air filters, I would like to ask the authors why they feel that a more desirable means for determining discoloration efficiency can be made by varying the volumes of the air sampled on the upstream and downstream side of the filter in preference to varying the area of the target.

As early as 1934 the *National Bureau of Standards* reported discoloration tests in which both the air volume and the area were varied, but there has always been some doubt in my mind as to whether or not different rates of sampling on the upstream and downstream side would involve catching more or less dust than should actually be represented by the sample. In other words, is it not desirable to maintain the same velocity in the sampling tube as in the duct? It appears that equal velocities would give more reasonable assurance of catching the pro-rata amount of dust. Aside from this there is always the difficulty of accurately measuring small volumes of air.

In Fig. 1 the authors show a very interesting curve giving the relationship between the physical and psychological interpretations of the lightness of a surface. I do not know whether or not this curve was plotted from data going in one direction only, but it is assumed that it will hold equally well for values from black to white as from white to black. The authors mention, however, that strictly speaking Fig. 1 is applicable only to the cases of black dust on a white background or white dust on a black background and is perhaps not too reliable for intermediate values. This raises the question as to whether the two original backgrounds as used by the authors would also apply without some reservation, because Fig. 5 indicates that lampblack on a black background gives a lower foot candle reading than the background alone.

Fig. 5 also indicates that with a white background the foot candle reading ranged from 40 ft-candles with the background alone to 7 ft-candles with the lampblack spot. A similar range of from 7 ft-candles to 35 ft-candles was read when using the black background with and without air floated silica. When Fig. 6A was plotted for lampblack on a white background, only the range of 40 ft-candles to 21.5 ft-candles was covered, with the 21.5 ft-candle value representing 0 per cent efficiency, and the relationship between filter efficiency and reflected light was assumed to be linear. Fig. 7A showing air-floated silica on a black background also shows a range considerably less than is indicated by Fig. 5.

The authors did not explain why a reduced quantity of dust was fed during these calibration tests, and no mention was made as to the permissible upper limit of target dirtiness or density. However, some experimental work of a similar nature was performed in 1939 in a laboratory with which I am familiar, and it was found that the relationship between reflected light and percentage efficiency was not a straight line unless particular care was taken not to overload the target. As a white background becomes covered with dust the reflected light is progressively reduced, but after the background is rather thoroughly covered, additional layers of dust will have only slight effect upon the reflectance. As a matter of fact, results of these tests indicated that for the dusts tested the relationship between dust fed and light absorbed was not linear when the absorption exceeded approximately 22 per cent.

This is a point which merits consideration, especially if crucible and discoloration tests are to be made simultaneously. Unless the concentration is reduced to a very low value, it will be necessary to limit the length of time for making the discoloration test in order to prevent overloading of the target.

The one other point which I would like to raise is that if black background targets are used, curve 7C indicates that a physical discoloration efficiency of 95 per cent would indicate a percentage *Value* of only 73 per cent. This means that a slight error in determining the physical efficiency in the range of from 95 per cent to 100 per cent would make a considerable difference in the *Value* readings. Conversely if a white background were used, the *Value* percentage would never fall below 72 per cent unless the physical discoloration efficiency of that filter were 40 per cent or less. This indicates that in most cases the useful portion of the *Value* curve is considerably reduced, irrespective of the type of background that is used for the target, and therefore a slight difference in psychological efficiencies might represent a considerable spread in physical discoloration efficiency.

Again may I commend the authors for their new approach to this interesting problem, and for their very excellent presentation of the subject matter.

Professor Rowley, referring to Mr. Penney's discussion, stated that the discoloration did not cover the full scale because it was impossible to get enough dust on the white background of the filter paper to cover the full range without scaling off. It was impossible to obtain a 100 per cent reduction in reflected light and consequently it was necessary to use the scale which could be obtained through the operating range and then to lengthen that scale to 100 per cent.

He stated that it was important to determine what results are being sought by use of the discoloration method. The great difficulty in filter efficiency code work and in determining filter efficiency has been caused by lack of a definite understanding of the objective. The objective will be different if it is to measure the discoloration as seen on draperies from what it would be if an attempt is made to measure the physical efficiency of the filter by a discoloration method.

Professor Rowley, in referring to Mr. Dill's comments, stated that filter papers had been selected for the tests. It was found, however, that there was more difficulty in selecting uniform filter papers for transmitted light tests than for reflected light tests. The difficulty with regard to the selection of filter papers exists for either method of testing. It was found very difficult to find two filter papers out of the same pack which would have exactly the same transmitted light.

The comparison of the discoloration rating with the performance in a room would depend upon the type of dust and the type of background used for rating. A rating for a white dust on a black background would be entirely different from the rating for a black dust on a white background. One of the difficulties of the discoloration method is that it is not possible to rate a filter under one set of conditions and have this rating hold for a practical application under different conditions.

Mr. Dill inquired whether the same difficulty would exist if the weight method were used.

Professor Rowley remarked that the difficulty would probably not exist with the weight method as used in the standard code. He referred to the difficulty of finding a standard dust that could be duplicated accurately and at the same time simulate the dust which the filter was expected to remove in practical operation. In establishing a weight efficiency rating it is very difficult to select filter papers which are equal because, even though they have the correct transmitted light at the beginning of the test, they could not be relied upon to give the correct transmitted light at the end of a test and give readings which would mean that the same amount of dust had been deposited on both filters. A filtering medium that would be exactly reproducible is needed for any method in which filter paper is to be used.

Professor Rowley stated that several tests had been run to determine the maximum loading of filter paper. It was probable that the efficiency curve would not be a straight line but, nevertheless, values read from a straight line would probably not make much difference in the results.

The quantity of dust on a filter paper can be determined in several ways. It can be weighed or determined by means of transmitted or reflected light or measured by the resistance of air flow through the filter paper. The air resistance method was used in the Society's Laboratory 15 or 20 years ago.

G. W. Hewitt, East Pittsburgh, Pa. (Written): In this paper the authors present two new types of efficiency which make use of discoloration—the *physical* efficiency and the *psychological* efficiency. These efficiencies are based on entirely different considerations than those on which the earlier type of discoloration efficiency was based. This earlier type, which may be called the *quantitative* or *matching* efficiency, is described in this paper also. These three types of discoloration efficiency vary widely, and the question arises as to which one has the most logical basis. Two of them are based on the degree of discoloration of surfaces after being subjected to a given quantity of cleaned and uncleaned air; the third is based on the amounts of cleaned and uncleaned air required to produce a given degree of discoloration (i. e., the *matching* of discoloration). It seems to me that the way in which air cleaners are actually used, determines which of the three is the most logical efficiency rating.

Suppose that an air cleaner is to be used in the following way. The walls, draperies, etc., in the cleaned air space are to be cleaned at definite intervals of time regardless of the degree of soiling (i. e., independent of the air cleaner efficiency). In this case, the degree of discoloration which the surfaces reach in the fixed interval between cleanings, is a function of the efficiency of the cleaner. In this case, the physical and psychological efficiencies have more meaning than the matching efficiency. Which of the two is the more significant depends upon the relative importance of the reflectance of the soiled surface, and the human eye's interpretation of the degree of soiling.

Next, suppose the air cleaner is used in a different way. The walls, draperies, etc., are cleaned not at regular intervals, but only when they reach a certain degree of soiling. The efficiency of the air cleaner then affects not the maximum degree of soiling, but the *length of time between cleanings of walls, draperies, etc.* In this case, is not the quantitative or matching efficiency the most logical since this efficiency rating is *based* on equal degrees of discoloration, or *matching?*

Besides this question as to which is the most logical method, I have two other questions. One has to do with

the effect of degree of discoloration of the filter papers (the discoloration obtained on unfiltered air may be designated the "base" discoloration). Is the indicated efficiency, either physical or psychological, independent of the choice of this "base" discoloration?

The second question also has to do with *base* discoloration. In Fig. 1 *value* is plotted from *black* to *white*. In the efficiency test the "base" sample is not *black* but *gray*. In calculating the psychological efficiency using Fig. 1, is the *gray base* assumed to correspond to the *black* end of the value scale? It seems to me that a change in zero is involved here. In the particular case shown by the authors in Fig. 6, the *base* reflectance appears to be approximately 44 per cent, and yet this apparently was assumed to correspond to black in Fig. 1. Taking this change in zero into account, I have calculated psychological efficiencies much lower than those shown in the bar diagram D of Fig. 6.

Matching efficiency has been used by several investigators and reported in several papers. It was referred to by Penney[2] in 1937, described by Dill[3] in 1938, and by Rowley and Jordan[4] in 1941. If, in general, air cleaners are used more for the purpose of increasing the time intervals between cleanings of walls, draperies, etc., rather than for decreasing their apparent discoloration at the end of fixed intervals of time, then the matching efficiency would appear to be the significant one.

Professor Rowley commented on Mr. Hewitt's discussion and stated that in applying the scale of Fig. 1 to any test the lower reflectance of test values was taken as the black end of the scale and the higher reflectance at the upper end, so that the scale could be applied directly.

Matching efficiency cannot determine the actual efficiency of a filter if more than one kind of dust and more than one dust particle size are used, because some filters will remove one dust more readily than others. For instance, if Pocahontas ash and lampblack are mixed together and a filter is used which takes out the Pocahontas ash very effectively but does not remove the lampblack, it is the lampblack which affects the filter test whereas the filter has actually taken out the other dust. If filters are rated by the matching method, the rating will not hold for applications unless the filter is to be operated on the same type of dust with which it is tested.

Any method of rating filters presents some difficulties when an attempt is made to apply the rating for a practical application.

Y. S. Touloukian, Cambridge, Mass., remarked that the manner in which curtains become dirty is entirely different from that in which a filter collects dirt. The discoloration method of rating, therefore, would not be applicable. He also mentioned that the methods of testing filters had neglected any attempt to determine the harm, damage, and deterioration which would be caused by dust.

Dr. W. H. Carrier, Syracuse, inquired whether a method had been developed for testing precipitrons, which remove fine particles of dust and fumes.

W. L. Fleisher, New York, N. Y., stated that a test period of 10 min or thereabouts was altogether too short and would be of no interest to the general user. He felt that the time element should be given further consideration in the testing of filters.

Professor Rowley in answer to Dr. Carrier stated that no work had been done using the fine dust such as that removed by a precipitron.

C. E. Bentley, San Francisco, Calif., suggested that filters should be tested in consideration of the health rather than the aesthetic viewpoint.

Professor Rowley stated that all tests were run for the purpose of obtaining the physical rating only.

Mr. Fleisher remarked that he had suggested during the past five years that the Society consider the incubation method of rating filters from a health viewpoint. In this method if samples of dust are taken before and after filtering, Petrie dishes can be used to determine whether colonies of bacteria will incubate. It will be found that from entering air regardless of its source, incubation of an infinite number of colonies of different coli bacteria and mold spores will occur. Complete absence of development of bacteria and coli on Petrie dishes may be obtained at times from air which has passed through even some of the more simple type of filters.

The size of particle which will pass through a filter can be measured microscopically and tests indicate that no particles under three microns will carry ordinary coli or bacteria, although they might carry virus.

Mr. Nottage stated that, since the eye and the normal photoelectric cell do not respond to the same extent to radiation of different wave lengths, it would be necessary to use a filter on the photoelectric cell to obtain a response comparable to that of the average eye. Professor Rowley stated that filters had been used, but that even with filters photoelectric cells did not respond exactly the same as the human eye.

Vice-President Downs then called for the next paper, The Axial Flow Fan and Its Place in Ventilation, by W. R. Heath and A. E. Criqui, which was presented in abstract by Mr. Heath (published in February 1944 Journal Section, Heating, Piping & Air Conditioning).

Mr. Seelig inquired whether in producing air flow in a test cell for engine testing the air had been drawn over the engine or had been blown against it. He mentioned that some of the aviation companies were using multi-vane fans on the roof of the building to deliver air through a 48 in. duct to the front of the propeller hub, thereby forcing the air through the hub of the propeller and over the engine. He suggested that perhaps an axial flow fan could be placed directly in front of the propeller to blow air through the propeller and over the engine in order to eliminate duct work.

Mr. Criqui stated that the air was drawn past the engine by the fan in cooling tests. A fan should not be too close to the engine, because if located in front it would influence the air flow into the propeller and also the air flow into the engine itself would not be the proper amount for the best results. If the fan were located to draw air over the engine it would be necessary to watch the temperature of the fan motor, particularly if the air became hot.

Vice-President Downs then presented T. H. Troller, who gave an abstract of his paper, The Aerodynamic Development of Axial Flow Fans (paper and discussion to be published in April 1944, Journal Section, Heating, Piping & Air Conditioning).

Fifth Session—Wednesday, February 2, 9:30 A. M.

The fifth session was called to order by President Blankin at 9:30 a.m. in the Georgian Room. He presented Major Arthur Nelson of the Corps of Engineers, U. S. Army, who spoke on the subject of Fuel Economy and Army Heating (to be published in April 1944 Journal Section, Heating, Piping & Air Conditioning).

E. T. P. Ellingson, Oklahoma City, Okla., remarked that the work reported by Major Nelson was so effective that those in charge of it should be permitted to institute the practice in other Army camps.

Capt. E. H. Lloyd, Washington, D. C., stated in reference to Mr. Ellingson's remarks that in more than a thousand instances the same type of fuel conservation program had been carried on by the Army. He then explained the set-up of this cooperation, that the Army had converted 54 per saving. He emphasized the cooperation of the Army with the Solid Fuels Coordinator and mentioned, as an example of this cooperation, that the army had converted 54 per cent of the oil burning installations to coal in territories where the fuel oil supply became critical.

The effectiveness of the program was demonstrated in the case of one Army post at which, before training began, 105 sets of grates were burned out in one month. After a training program had been instituted only two sets of grates had been burned out for the balance of the heating season after the month of January.

A. N. Volkhardt, Staten Island, N. Y., stated that within his observation barracks were still being built with one or two feet of air space underneath and with single floors on 2 x 8 or 2 x 10 joists. It seemed to him that the lessons learned in the fuel saving program should have resulted in some improvement in new construction. He inquired whether studies had been made to determine the value of an air space formed under the floor by fastening building paper under the floor joists.

Major Nelson, referring to Mr. Volkhardt's comment, stated that many barracks were previously built with refer-

[2]A New Electrostatic Precipitator, by G. W. Penney. (AIEE Transactions, Vol. 56, 1937, p. 159.)

[3]A Test Method for Air Filters, by R. S. Dill. (ASHVE Transactions, Vol. 44, 1938, p. 379.)

[4]A Comparison of Weight, Particle Count, and Discoloration Methods of Testing Air Filters, by Frank B. Rowley and Richard C. Jordan. (ASHVE Transactions, Vol. 47, 1941, p. 29.)

ence to speed of construction rather than heating efficiency because of necessity. Construction had, however, been improving and in many cases after sealing the space under the floor warm air was returned to the central furnace under the floors and thereby warmed the floors and reduced draft.

Captain Lloyd remarked that many changes in plans for new construction were being made as a result of the information obtained in carrying out the fuel saving program. He mentioned the desire of the Army to receive constructive suggestions from members of the Society.

H. M. Hart, Chicago, Ill., expressed his satisfaction in knowing that the Army was cooperating so well in the fuel saving program. He hoped that data were being obtained with reference to the wind velocity and direction, so that its effect on fuel consumption could be determined at a later date.

K. C. Richmond, Chicago, Ill., stated that in 25,000,000 single family dwellings and 5,000,000 multiple dwellings, some of which are 30 years old, it is safe to say that fuel is not being fired with any more skill than that originally observed in the Army camps.

Over 100,000,000 tons of bituminous coal are burned annually for domestic heating and at least 10 per cent of it is wasted. Half of the cast-iron boilers and 57 per cent of the warm air furnaces manufactured in the past 25 years have been used for replacement. He also mentioned that 200,000 fires are caused each year by defective heating equipment.

President Blankin mentioned the work of the ASHVE War Service Committee in bringing fuel saving suggestions to various government agencies.

John Howatt, at the request of President Blankin, described methods of saving fuel which had been introduced into the Chicago schools, in which a saving of 10 per cent of the annual fuel consumption of 200,000 tons had been established as a goal.

President Blankin closed the discussion with the remark that if savings similar to those obtained by Major Nelson's organization could be made universal there would be an annual saving in the United States of over 400,000 car loads.

President Blankin then introduced George T. Seabury, Secretary, American Society of Civil Engineers, who spoke on the subject of Collective Bargaining for Engineering Employees. Mr. Seabury reviewed the history of the approach of collective bargaining as observed by the ASCE. Attention of the ASCE was first directed to the inroads of labor organizations in 1936, and consequently, a committee was formed in 1937 to determine the extent of such inroads. The committee found that a number of pressure groups, some related to and independent of organized labor were active and wrote a report which was published by the ASCE in 1938.

Among the significant statements appearing in the report were the following: "Membership in a trade Union is primarily an economic matter, therefore, the ASCE should consider such membership as having no more bearing upon a man's qualifications for membership in the Society than for his religious or political affiliations. The Wagner Labor Relations Act has encouraged the extension of existing unions, formation of others, and has paved the way for complete unionization of the employees of many industries and it may be expected to result in the formation of collective bargaining groups in all plants and offices where any considerable number of people are employed. Engineers and architects, as well as draftsmen and other professional men are not and cannot be exempt from the provisions of the Act."

As a result of investigation made throughout the United States, the Board of Direction of the ASCE requested the committee on employment conditions to establish a program which included instructions for local sections to make provisions for collective bargaining groups to be composed of and controlled by ASCE members, but including non-members who would be eligible to join the group. At the conclusion of his address Mr. Seabury answered a variety of questions which were asked by members of the audience.

Sixth Session—Wednesday, February 2, 2:00 P. M.

President Blankin called the meeting to order and stated that the paper to be presented by Prof. F. W. Hutchinson, Berkeley, Calif., was a result of cooperative research between the Society and the University of California. Professor Hutchinson presented an abstract of the paper, Optimum Surface Distribution in Panel Heating and Cooling Systems (published in November 1943 Journal Section, Heating, Piping & Air Conditioning).

L. T. Wright, Jr., Ithaca, N. Y., inquired: (1) whether the surface of the dummy as used in the paper was the area exposed to radiation, and (2) whether *full face view* meant that the normal through the center of the body would pass through a normal from the center of the ceiling panel.

He differed with Professor Hutchinson in regard to the influence of the heat transfer characteristics of the walls, because he felt that in radiant heating the problem was to obtain equal comfort conditions throughout the room.

R. A. Miller, Pittsburgh, Pa., asked whether an investigation had been made of the possible use of concave or convex panels.

Professor Hutchinson in replying to Mr. Wright's questions stated that the average effective surface used was 16 sq ft and that the *full face view* meant that the dummy was facing the panel under consideration. He agreed that if some of the surfaces were cold, the basic panel distribution obtained for uniform wall and floor surfaces should be corrected and that this correction could be made by investigating the existing distribution of cooling panel surface and superimposing it on the necessary distribution of heating panel surface.

In reply to Mr. Miller, he stated that work was being done upon parabolic reflectors for use in local heating.

F. E. Giesecke, College Station, Tex., drew a distinction between *radiant heating*, in which the occupant feels the heat as from a fireplace or electrically heated panel, and *panel heating* in which large surfaces are at a temperature a few degrees above the air temperature. He stated that the difference between the mean radiant temperature and the air temperature when static conditions existed would not be more than two or three degrees.

Panel heating was not fundamentally different from any other kind of heating in his opinion. He suggested that when panel heating is used, the entire ceiling or the entire floor should be heated. He remarked that in England it has finally been concluded that the ceiling is the most suitable area on which to place the radiant panels.

Ralph E. Hacker, Fort Lee, N. J., asked what effect mechanical ventilation would have upon radiant heating.

Professor Hutchinson referred Mr. Hacker to a previous paper, Panel Heating and Cooling Analysis by B. F. Raber and F. W. Hutchinson, for a reply to his question.

K. C. Woodward, Waterbury, Conn., asked whether Professor Hutchinson could provide a simple method for laying out a panel heating installation.

Professor Hutchinson stated that he was making no attempt to show how a panel heating system should be designed.

R. G. Vanderweil, Waterbury, Conn., mentioned a visit he had paid in 1937, to a hospital, in Rome, used for tuberculosis patients. Because of the use of radiant heating, patients were able to walk around in light clothing and be comfortable even though the impression upon a person entering was that the air seemed cool.

Dr. C.-E. A. Winslow, New Haven, Conn., stated that he did not agree with Dr. Giesecke that there was a differentiation between radiant and panel heating, although he did think there could be a distinction between high temperature radiation and heating by moderately warm surfaces. The whole value of panel heating is that all parts of the room, the walls, the floor, the ceiling, and also the air after awhile will assume almost identical temperatures, so that in a properly panel heated room there is less inequality of exposure than there is in the ordinary convection heating system. The unique characteristic of the panel heating system is that from a physiological standpoint the occupant is exposed to very even environment.

Mr. Miller spoke of the progress that had been made in developing heating panels of tempered plate glass which had been first developed in Europe. By equipping the panels with the proper amount of resistance in aluminum or other metallic bands, it would be possible to use these panels in the ceiling or in any walls which were to be heated.

Y. S. Touloukian, Cambridge, Mass., inquired whether effective temperatures for comfort which take into consid-

eration air velocity, humidity and other factors would change the shape of the curves shown in the paper.

F. E. Giesecke stated that panel heating was used in the open air hospitals in Switzerland and that the Swiss physicians stated that panel heating was more sanitary than other types of heating because convection currents and, consequently circulation of dust particles, are less likely to occur with this type of heating.

Dr. Giesecke stated that heated panels might be obtained either by embedding pipes within the surface or by circulating warm air between the ceiling and a false ceiling or possibly by circulating warm air across a room under the ceiling.

L. E. Seeley, New Haven, Conn., remarked that the reaction of the Society to Professor Hutchinson's paper was the same as that of the Society to Prof. R. C. Carpenter's formula for determining building heat loss and this reaction was "that is all very well, but it is pretty theoretical."

James Holt, Cambridge, Mass., related his experience in heating a swimming pool in which panel surface was installed above the deck of the pool, around the four sides, and also in the floor of the deck of the pool on four sides. Due to the installation of a window, 30 ft high by 100 ft long, on the south side of the pool, it was necessary to place inside of the window a second partition about 10 ft high located 2 ft from the window. By supplying ventilation air between the panel and the window, cold drafts from the window were prevented. It was found in operation of the system as described that comfortable conditions for the swimmers were obtained at all times.

Capt. E. H. Lloyd, Washington, D. C., stated that it would be desirable to have a simple method for computing radiant heating even though the method might not be extremely accurate.

H. M. Hart, Chicago, inquired about the relative effectiveness in panel heating of copper and steel pipe when embedded in plaster. He also inquired about the source of the information on heat output of panels as given in The Guide and inquired about its accuracy.

Professor Hutchinson in replying to Captain LIoyd expressed the belief that no attempt would be made on his part to outline a method for designing panels.

In reply to Mr. Touloukian, Professor Hutchinson stated that no change would occur in the curves presented in the paper because they were based upon geometry and Boltzman's radiation equations and consequently would not be affected by, and did not represent values which would be changed by, a consideration of other factors affecting comfort.

He paid a tribute to Dr. Giesecke, Dr. Winslow and Professor Raber in stating that his interest in radiant heating had arisen from conversations with these three gentlemen.

C. H. Flink, New York, in reply to Mr. Hart, stated that all information in The Guide is obtained through members of the Society and that as quickly as information can be extracted from the members and compiled it is included in The Guide. It was recognized that the subject of radiant heating is still in a state of progress and that it may not be possible to develop the simple procedure desired by some of the members for some time, perhaps two years or more.

Brig.-Gen. W. A. Danielson, Memphis, described his experience with solar heating systems for hot water supply and stated that he had been referred to tests run at the University of California for the relative transmission of heat from copper and steel into masonry materials. In the report mentioned, he found the suggestion that pipes should be embedded in a mixture of sand and cement in order to get the benefit of the increased transmission of heat from the sun into the water.

Professor Holt, in referring to Mr. Hart's question, stated that in order to prevent cracking of plaster and concrete, he had used wrought iron and steel pipes embedded directly in concrete.

W. L. Fleisher, New York, stated that by insulating buildings walls were made warmer and consequently the radiation from the body to cooler surfaces would be less than for buildings constructed with uninsulated walls. He referred to panel heating installations made in Rome in the first century A. D. In one installation in England which he had examined the walls were so massive and held heat to such an extent that it took almost two days for the structure to cool in mild weather to the point where the occupants could be comfortable within it.

He emphasized the importance of taking into account the mass of the structure and the variations in climate in designing panel heating systems using panels, because, in order to be adaptable to variations in climate, the structures must be able to lose and gain heat fairly rapidly if constant conditions are to be maintained.

He stated that consideration might also be given to the use of bright or low emissivity surfaces in construction of buildings using panel heating in order to prevent radiation of heat to cold objects.

Mr. Woodward stated that steel and wrought iron did not have the same coefficient of expansion as cement plaster.

H. F. Randolph, Utica, N. Y., stated that regardless of the type of heating system the heat losses from any given structure must be the same. In the example quoted in The Guide, two methods of calculation produced different values for the heat loss and consequently one method must be wrong.

Professor Holt in referring to the comment made by Mr. Woodward stated that the coefficient of expansion of wrought iron pipe is the same as that of concrete. While he agreed that all plasters did not have the same coefficient of expansion, he had found that the plaster used in the installation which he had previously mentioned did have the same coefficient as wrought iron pipe. It would be necessary before embedding pipe in plaster to make certain that the coefficients of pipe and plaster were the same.

Professor Hutchinson referred Mr. Randolph to a discussion of the paper[5] which had been prepared by Professor Raber and himself. In this discussion comparisons were given between three methods of calculation for panel heating surfaces. He referred Mr. Fleisher to a paper[6] previously presented to the Society, for tests showing how reflectivity affects comfort in a room. He pointed out that in a room with reflective surfaces, even without heat, comfort can be obtained at low temperatures.

President Blankin stated that permission had been asked for a discussion from the floor concerning the Kilgore bill on which hearings were now being held in Congress.

W. C. Randall, Detroit, stated that he had received from the National Association of Manufacturers a copy of an abstract of the Kilgore bill. This had been brought to the attention of the Board of Governors of Michigan Chapter which passed a resolution expressing the opinion that Bill SO2 and its companion measure HR2100 now pending are undesirable and requested that the Society give consideration to this matter at the 50th Annual Meeting.

Michigan Chapter was interested in determining the reaction of the national organization of ASHVE toward the bill. President Blankin stated that the matter had been referred to the War Service Committee and asked Mr. Howatt to make a report.

Mr. Howatt said that the Committee had kept itself informed on the progress of the bill and that, as there appeared to be some possibility that lately it had been given added impetus, it should be referred to the new ASHVE Council for consideration of the various features which it contained. Senator Kilgore had promised to communicate with Mr. Howatt regarding the date for a hearing on the bill. Mr. Howatt felt that the Society should not at this time adopt a resolution expressing an opinion of the bill, but that the matter should be referred to a Committee for study.

L. P. Saunders, Lockport, N. Y., expressed the opinion that very little attention would be paid to any resolution which might be passed and consequently the only effective way to influence legislation would be for each member to write directly to his congressman.

Ferdinand Jehle, Indianapolis, stated that the American Association for the Advancement of Science was against the bill.

W. A. Danielson emphasized the disastrous effect which centralized control of learning might have and felt that such control should not be permitted to the slightest degree.

R. A. Miller stressed the importance of taking action regarding the bill.

On motion of Mr. Howatt, seconded by Mr. Fleisher, it was voted:

THAT the President appoint a Committee to study the Kilgore bill and to take appropriate action regarding it.

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[5]Performance of a Residential Panel Heating System, by H. F. Randolph and J. B. Wallace.

[6]The Performance of a Panel Heating and Cooling System, by B. F. Raber and F. W. Hutchinson. (ASHVE Transactions, Vol. 48, 1942, p. 35.)

President Blankin recognized R. A. Folsom, San Francisco, chairman of the Resolutions Committee, who presented the following resolutions which were unanimously approved.

Resolutions

Whereas, our President, Merrill F. Blankin, during the past year has devoted his untiring efforts to the advancement and well being of the American Society of Heating and Ventilating Engineers and

Whereas, the results of his able and continuous concentration on Society duties at very great sacrifice to his other business and personal affairs, have been manifest in the virility and the substantial progress of every phase of Society activities and,

Whereas, his visits to the various local chapters have been a source of inspiration and stimulation and have added greatly to the welding of the membership into a unified and closely knit organization,

Be It Resolved, that the American Society of Heating and Ventilating Engineers expresses its thanks and appreciation for his capable leadership and also for the gracious assistance of Mrs. Blankin who accompanied him on many of his visits, and

Be It Further Resolved, that the thanks and appreciation of the Society also be conveyed to all of the other Officers and to the Council who have so diligently served its interests throughout the year.

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Whereas, the administration of the Society's activities under the leadership of its officers has been so ably carried on by the Council, the Council Committees and the Advisory Council, and

Whereas, the special activities of the Society have been handled by Special Committees, the Committee on Research and the Technical Advisory Committees, and

Whereas, the Council, the Chairmen, and the Members of these groups and Committees have at great personal sacrifice unstintingly given of their time in this work, and

Whereas, the members of the Society anticipate with pleasure the receipt of the new Guide on which the Publication Committee has worked so long and diligently,

Now Be It Resolved, that the American Society of Heating and Ventilating Engineers and its members assembled at this 50th Annual Meeting express their thanks and gratitude to those individuals who have so willingly served and who have been in such a large measure responsible for the continued advancement of the Society and its activities,

Be It Resolved, that the American Society of Heating and Ventilating Engineers recognizes with the greatest of pleasure the presence at this 50th Anniversary Meeting of 19 of the 23 living past presidents and expresses its grateful appreciation for their continued interest and participation in its work, and

Be It Further Resolved, that an expression of good wishes and greetings be conveyed to our two Charter members, Homer Addams and Charles F. Hauss, together with the regrets of the membership that they were unable to attend this meeting.

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Whereas, the 50th Annual Meeting of the American Society of Heating and Ventilating Engineers ending a half century of continued progress in the heating and ventilating engineering field is now about to be concluded, and

Whereas, the Technical Sessions, the Entertainment, the Committee Meetings and business matters presented, have been of unusual interest and exceptionally stimulating to those in attendance,

Be It Resolved, that an expression of thanks and appreciation be adopted and that copies of this resolution be published and sent to each of the persons and agencies who have contributed toward making this 50th Annual Meeting so successful and enjoyable.

To the Honorable Fiorello H. La Guardia, Mayor of the City of New York, for his able address on The Post War Era Offers a Challenge to Engineering;

To R. H. Carpenter for his services as toastmaster at the Get-together Luncheon;

To the Engineering Societies, Associations and individuals who sent representatives and messages of greetings and felicitations to the ASHVE on the occasion of its 50th Anniversary;

To the Officers and Members of the New York Chapter and their ladies who have welcomed us and who through their cordial hospitality have made our visit so enjoyable;

To the Honorary Chairmen, Homer Addams, W. H. Carrier, W. H. Driscoll, W. L. Fleisher and D. D. Kimball;

To the General Chairman, Alfred J. Offner, and the Ladies' Co-Chairmen, Mr. and Mrs. H. J. Ryan, who have been most considerate of our every desire;

To the Chairmen and Members of all other Committees of the New York Chapter who have given so generously of their time to insure the success of this meeting:

To the Presiding Officers of the Technical Sessions and to Dr. Baldwin M. Woods, who guided the panel discussion;

To the authors and their associates who have prepared and presented the excellent technical papers;

To Mr. Samuel G. Hibben, Director of Applied Lighting of Westinghouse Electric and Manufacturing Co. for his entertaining demonstration and address on Tomorrow's Uses of Radiant Energy;

To the Management and Staff of the Hotel Pennsylvania for their fine cooperation and service and the special courtesy of arranging for the ladies to inspect the Statler Research Kitchen;

To the New York Convention and Visitors Bureau for their generous assistance and cooperation and the special service rendered in handling registration and furnishing special information about the City of New York;

To the New York newspapers for their coverage of this meeting, and to the trade magazines for their generous cooperation and the attendance of their representatives;

To N. B. C., Columbia Broadcasting Co., and Philco Corp., for their courtesy in furnishing tickets for several broadcasts, and a special greeting to Fred Waring and his company for their salute to the Society;

To Rockefeller Center for the opportunity afforded our members to inspect the mechanical equipment.

Respectfully submitted,
RESOLUTIONS COMMITTEE,
R. A. FOLSOM, *Chairman*
WILLIAM GLASS
H. BERKLEY HEDGES

President Blankin introduced W. T. Jones, Boston, who conducted the installation of the Society officers and new members of the Council for 1944. President-Elect S. H. Downs, Kalamazoo, Mich., was presented with the gavel and made the following remarks:

Fellow members and guests of the American Society of Heating and Ventilating Engineers: I certainly feel very grateful and deeply appreciative of the honor and responsibilities that go with the office of President of this Society. One could not come to this meeting in New York without having experienced a great deal of inspiration, not only because of the very large registration but also because of the very great enthusiasm that has been shown by all present.

This meeting, so far as I am concerned, has certainly been the most enthusiastic that I have ever attended. It is an indication to me, and, I am sure, to all the other officers whom you have seen installed, and also those who have been absent, that this coming year is certainly going to be a year of upsurge in the activity and interest of all members of this Society.

With that in mind your past presidents and Council have already made some plans to fulfill this destiny, and your new Council and officers tomorrow will hold another meeting, at which time we hope not only to carry on the present plans, but also to add to them. Thank you.

The meeting adjourned at 4:25 p. m.

Get-Together Luncheon

The Get-Together Luncheon on Monday was opened by Toastmaster R. H. Carpenter who introduced the Hon. F. H. LaGuardia, Mayor of the City of New York, who spoke on Post-War Era Offers a Challenge to Engineering. The Mayor outlined the city's post war plans which will provide employment for 200,000 and he emphasized the fact that New York is further advanced on its post war planning program than any other City, State or the Federal Government. The Mayor indicated that the program would include schools, hospitals, courts, police and fire stations, sewage disposal facilities, playgrounds and street and highway improvements. Mayor LaGuardia told his audience that the city wanted to have the last word in heating and ventilating, cleaning and sanitary appliances, and he also indicated that it was up to the engineers who have been creating things to insure the success of the public works program after, as it can't be done by amateurs, nor by lawyers or professional politicians.

Past-Presidents' Dinner

At 6:30 Monday evening 16 Past-Presidents gathered for dinner in Parlor C of the Hotel Pennsylvania and enjoyed a reunion that has become traditional.

Modern Uses of Radiant Energy

The control of mold and decay, the elimination of many of the hazards associated with darkness, even the extension

FIFTIETH ANNIVERSARY BANQUET
AMERICAN SOCIETY OF HEATING
AND
VENTILATING ENGINEERS
HOTEL PENNSYLVANIA NEW YORK CITY
FEBRUARY 2, 1944
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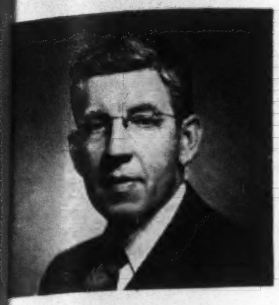

S. G. Hibben

of the human life span itself, were some of the benefits to be expected from new uses of radiant energy, was the prediction of Samuel G. Hibben, in an address Monday evening to a group of 500 members and ladies. Mr. Hibben, director of applied lighting at the Westinghouse Lamp Division, Bloomfield, N. J., said that ultraviolet radiations, such as those produced by an ultraviolet lamp, can reduce food spoilage by preventing the formation of mold and decay. These same radiations can also purify the air we breathe and the articles we touch with our lips, thus lessening the spread of many diseases and making the air we breathe indoors more healthful.

Engineers responsible for the creation of healthful indoor weather conditions may depend more and more upon radiant heat as a necessary adjunct in heating our homes and offices. This same radiant energy might also be used in the field of quick cooking and in the drying and preserving of foods. Radiant heat, because it can be quickly applied and easily localized, offers a saving in fuel and a desirable increase in human comfort.

Now filling many industrial needs in the nation's war plants, radiant heat has speeded production by making possible the quick, efficient drying of many different types of war equipment. For example, it is used today to dry the painted surfaces of army tanks and jeeps, in addition to speeding the production of such diverse products as guns, shells, hand grenades, foundry molds and the manufacture of plastic army helmets.

Mr. Hibben explained that many accidents caused by inadequate lighting are preventable and can be materially reduced. One step in this direction he said might be the use of fluorescent lighting in such danger spots as halls, stairways and other locations. He demonstrated the use of several types of lighting for producing startling and beautiful effects on fabrics and other materials, which might be used in decorating the homes of the future.

Old Timers Reunion

Nearly 500 members and ladies enjoyed the Old Timers Reunion on the Roof of the Hotel Pennsylvania at 9:00 P. M. Monday evening. As the members assembled, A. C. Buensod's Special Events Committee, with the assistance of a "special policeman" of 19th century vintage, escorted the men to a special parlor where their appearance was "improved" by the proper application of mustache and beard of the gay '90's. A buffet supper was served, and the group enjoyed square dancing and the more modern versions of the art.

Annual Dinner

The grand ballroom of Hotel Pennsylvania was the scene of a brilliant gathering of nearly 800 members and guests on the evening of Feb. 2. After the singing of the national anthem a group picture was taken and following the service of dinner, W. H. Driscoll, Syracuse, N. Y., toastmaster and past president of the Society, greeted those present and said that the dinner was a fitting climax to a fine meeting celebrating the 50th Anniversary of the Society. He said that our Society has come gloriously through the first half century and stands strong, vigorous and well prepared for the days ahead.

He briefly reviewed some of the important milestones in the founding of the Society and recalled some of the memories of *Little Old New York* during the past 50 years, and paid tribute to our two remaining Charter Members, Homer Addams and Charles F. Hauss, who unfortunately, could not attend.

Merrill F. Blankin, Philadelphia, Pa., was introduced and expressed his pleasure in being able to represent the *Institution of Heating and Ventilating Engineers* of England, whose president, Richard Crittall, had delegated him to present a silver medal to a member of both the British Institution and the American Society, Thomas Chester, Detroit, Mich., who had presented the best paper to the Institute during the five-year period 1937-42 on the subject of Drying by Heated Air.

After a brief acknowledgment of the honor by Mr. Chester, Toastmaster Driscoll requested Mr. Blankin to present the F. Paul Anderson Award given by the Society for outstanding service to the arts and science of heating, ventilating and air conditioning. Mr. Blankin announced that Lt. Comdr. F. C. Houghten, USNR, had been chosen for this honor, and he briefly reviewed Commander Houghten's contributions in the field of research and his service as secretary of the Society, 1924-25, and as Director of the Research Laboratory 1925-42. Commander Houghten made a brief response and said that he was reminded that honors, acclaim and position in life rarely come to a man as the result of his own efforts and said that it was a great privilege to receive the medal which he considered the greatest honor that he had ever received.

Prof. E. O. Eastwood, Seattle, Wash., was then called upon to make the annual award of the past president's emblem to Mr. Blankin, the retiring president. Professor Eastwood briefly reviewed Mr. Blankin's services to the Society and said that in presenting the past president's emblem in the name of the Society, it was given in appreciation of the services rendered by Mr. Blankin, and in token of the high esteem in which the membership holds him. Mr. Blankin expressed his thanks and then expressed the hope that he could continue to serve the Society's interests for many more years.

Toastmaster Driscoll said that the guest speaker of the evening was probably known to many of the audience because of his many forceful speeches over the radio and from many platforms—Dr. Daniel Poling. He described Dr. Poling as a minister, as a leader in civic movements, as an editor, radio speaker, and as an active worker in both the first World War and the present conflict. He said that Dr. Poling, during the past year, had visited all of the war fronts, with the exception of Australia, and was familiar with the troops in all of these theaters of war.

Dr. Poling's subject was "The War on Four Fronts," and he gave a vivid description of his experiences of seven months overseas and contrasted some of the factors that made the present war a new kind of war as compared with World War 1. (The text of Dr. Poling's address will appear in a later issue.)

Toastmaster Driscoll expressed the sentiments of the audience and their great appreciation for the fine address of Dr. Poling, saying "I am sure that as long as any man or woman in this audience attends meetings of this Society, they will recall this talk as one of the highlights in the entire history of the American Society of Heating and Ventilating Engineers."

Harry Armstrong, composer of "Sweet Adeline" leads the Past Presidents Glee Club

Some Old Timers posing in the best traditions of the Gay 90's

Zeke Lockwood directs a Square Dance at the Old Timers Reunion

Progress in Development of Standards for Comfort Air Conditioning

By Ferry C. Houghten* (D.Sc.), Washington, D. C.

THE HISTORY of the early development of standards for comfort air conditioning, like the history of the beginning of comfort air conditioning itself, is not clearly recorded in our annals. Certain it is, however, that at the time of the organization of the American Society of Heating and Ventilating Engineers in 1894, the warming of the air in habitations was the chief concern of the heating and ventilating engineer.

During and following the first World War, other conditions of the atmosphere were being considered. One of the first attempts to catalogue and understand the importance of the several physical and chemical properties of man's atmospheric environment was the development and presentation (2)† to the Society of the synthetic air chart by Dr. E. Vernon Hill. This work served several useful purposes in the early development of comfort air conditioning: first, by cataloguing the several factors concerning the atmosphere known to affect the comfort and well-being of man, wide publicity and acceptance was given to their importance; second, by attempting to evaluate these factors in terms of the knowledge then available, attention was centered on the lack of any semblance of accepted quantitative data on many phases of the subject. A good example of the lack of acceptance of standardized values concerning comfort air conditioning was the wide difference of opinion concerning the effect on a person's feeling of warmth of such physical conditions of the atmosphere as its dry-bulb temperature, moisture content, and motion. Dry-bulb alone still received general acceptance. The chart went to the other extreme of accepting the wet-bulb temperature as the controlling factor. Contrasted with the views of Dr. E. Vernon Hill, as expressed in the synthetic air chart, Dr. W. H. Carrier and others, based upon theory and broad experiences gained through application in the field, held that both dry-bulb and wet-bulb were effective in determining a person's feeling of warmth. The wholesome controversies concerning these points drew attention to the then current work of Dr. Leonard Hill and others. Probably more than any other single influence, these controversies served to direct attention to the need for laboratory research in this branch of the engineering profession and industry, and eventually to the organization by the Society of its Research Laboratory in 1919.

Dr. C.-E. A. Winslow and his associates on the New York State Commission on Ventilation, and the reports of their work, served a most useful purpose in that the discussion (7) of the report calls attention to the importance of the condition of the atmosphere in the enclosure rather than whether ventilation was supplied by open window or by mechanical means.

The Comfort Chart. It may now be said that the controversies of the late teens and early twenties, which at times became acrimonious,

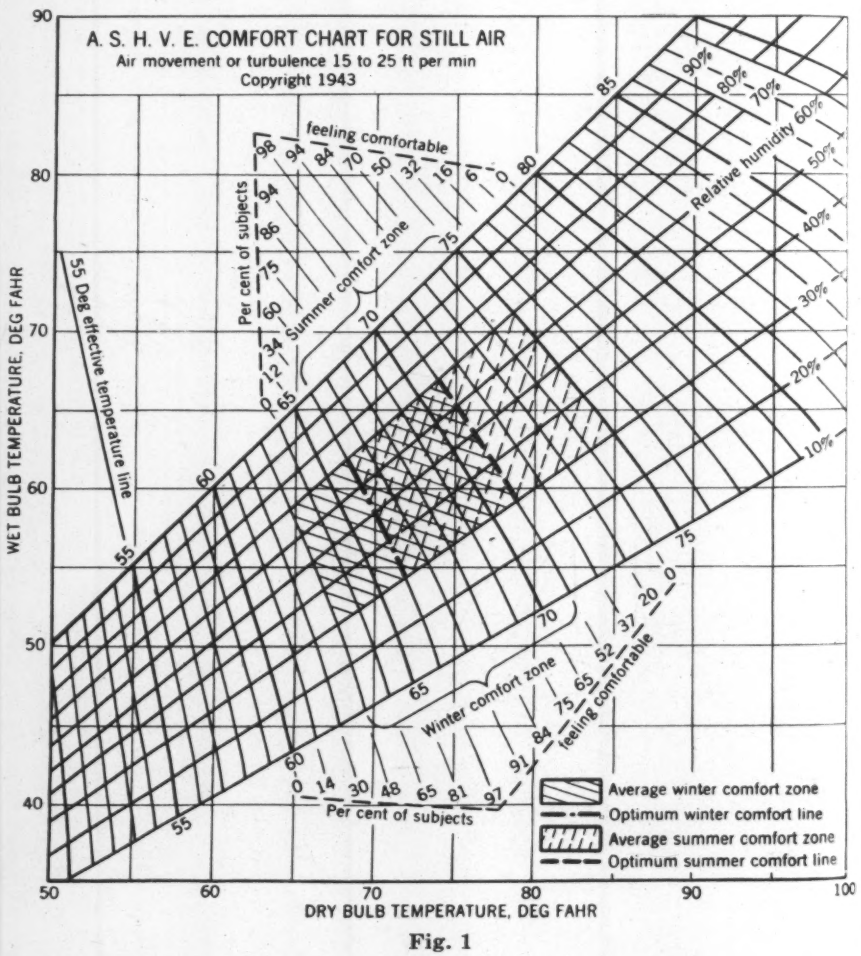
A. S. H. V. E. COMFORT CHART FOR STILL AIR
Air movement or turbulence 15 to 25 ft per min
Copyright 1943
feeling comfortable
Per cent of subjects
Summer comfort zone
55 Deg effective temperature line
Relative humidity
Winter comfort zone
Per cent of subjects
Average winter comfort zone
Optimum winter comfort line
Average summer comfort zone
Optimum summer comfort line
WET BULB TEMPERATURE, DEG FAHR
DRY BULB TEMPERATURE, DEG FAHR

Fig. 1

*Lt. Comdr., USNR, Research, Air Conditioning Section, Bureau of Ships. Also Research Division, Bureau of Medicine and Surgery. Member of ASHVE.

†Numerals in parentheses refer to Bibliography.

The opinions and assertions contained in this paper are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.

Presented at the 50th Annual Meeting of the American Society of Heating and Ventilating Engineers, New York, N. Y., January 1944.

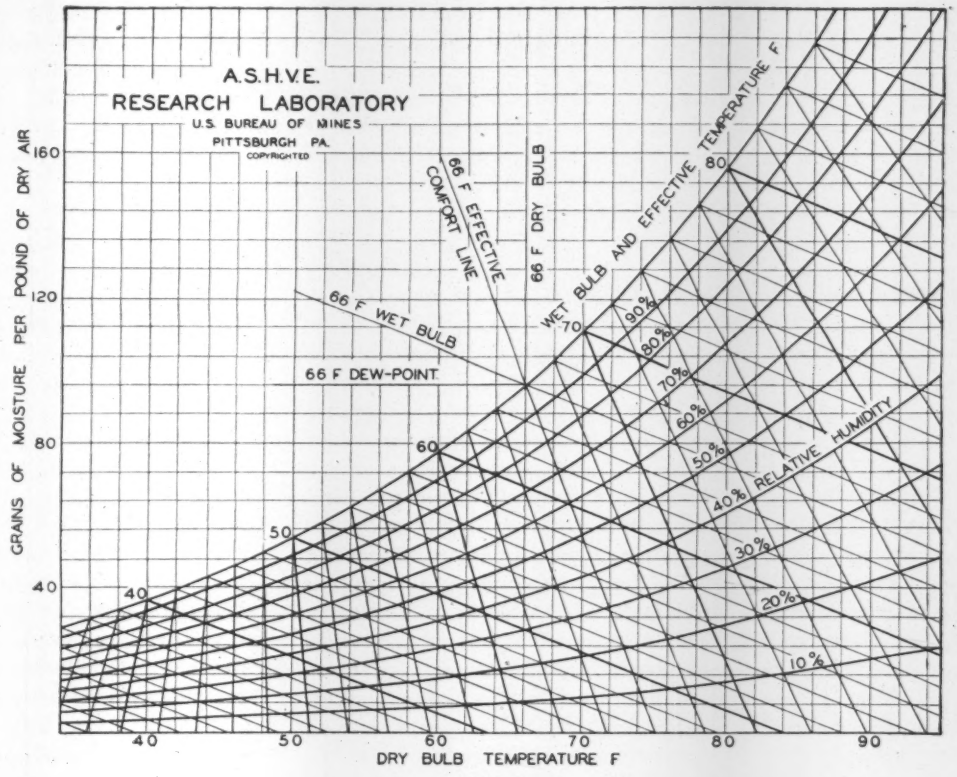

Fig. 2

served in no small measure to supply the incentive and determination for the following twenty years of prolific research which has marked the achievement of a half century of success by the American Society of Heating and Ventilating Engineers. Important in the program outlined by the Committee on Research, upon the organization of its new laboratory, was the development of standards of atmospheric conditions for the comfort of man. The first of these standards to be considered was the relative effect on a person's feeling of warmth, of the dry-bulb temperature, the moisture content, the movement or velocity of the air, and the radiant heat. This study resulted in a number of reports and the development of the well-known Comfort Chart of the Society, Figs. 1 and 2. The first report (6) of this work was presented to the Society at its 1923 annual meeting in Washington, and gave the basic chart for men in still air, stripped to the waist, as in hot industry. This was followed by additional reports (11) showing the effect of air velocity on the feeling of warmth of a person in atmospheres of different temperatures and humidities. In these early studies the effect of radiant heat was made constant by insulating the walls, so that the surfaces in view of occupants were at approximately the same temperature as the air dry-bulb temperature. Later work gave corrections to the basic chart for persons normally clothed and seated at rest, so that the chart, Fig. 1, in the form in which it is now used became available to the Society in 1925 and it has not been revised since.

Continued work on the effective temperature index during the past eighteen years, both in the laboratory and elsewhere, has shown that the slope of the lines vary to a small extent with a number of variables, including the individual concerned at the time the observation is made, his clothing, his perspiration rate, and his activity. Other physical factors which affect the accuracy of the lines as drawn on the chart, are the air velocity and radiant heat. Data concerning the effect of the former are available, and the location and the slope of the lines may be corrected for the effect of air velocity if the velocity is known. The relative effect of radiant heat on a person's feeling of warmth, as compared with the effect of air temperature, moisture content and velocity, has been studied in recent years at the Society's Laboratory (59 and 62a) and by Bedford in England. While much has been learned, the results are not yet sufficiently conclusive to permit correcting the comfort chart for the effect of radiant heat. It probably accounts for a number of instances where the results of different observers have not been in complete agreement.

More recent studies have demonstrated (59) that a person is only sensitive to a variation of about 3 deg ET if the change is made slowly; that is, if a person in a given atmospheric condition feels ideally comfortable in his sensation of warmth, the temperature would have to be lowered or raised approximately 3 deg ET before his sensation would positively register cooler or warmer. If a person goes quickly from one environment to another he is sensitive to a change of ½ deg ET. This sensitivity cannot be realized in practice, however, because of the personal and physical variables cited. Taking all these different factors into account on a statistical basis, a minimum change of about 1½ deg ET is significant. Most of the possible variations in the accuracy of the effective temperature lines, suggested from time to time, fall within a range of from ½ to 3 deg ET.

Two outstanding suggestions in-

dicating possible variations in the accuracy of the slope of the lines have been made. Studies (50) at the Pierce Laboratories, Yale University, indicate a more critical change in the slope of the lines for conditions resulting in change from insensible to sensible perspiration. This is demonstrated by the difference between the two curves, *Pierce Evaporation* and *ASHVE Evaporation*, in Fig. 3. The main difference between these two curves, above 70 F, may be accounted for by the fact that the subjects in the two studies were not equally active or clothed alike. The discrepancy between the two curves, which would indicate a change in the slope of the effective temperature lines, is the rapid change in slope of the *Pierce Evaporation* curve at approximately 86 F, as contrasted with the gradual change in the slope of the *ASHVE Evaporation* curve. However, the magnitude which this question may involve concerning the accuracy of the slope of the effective temperature lines, as shown in Fig. 3, will be considerably less than the three degrees sensitivity of any individual.

More recently there was a question raised concerning the accuracy of the slope of the effective temperature lines for very hot environments in the neighborhood of 95 deg ET. A check (66) of the lines in this region of the chart, both by primary sense reactions and by physiological reaction, indicates that their slope may require a slight change, possibly to the extent that 95 deg ET at 30 per cent relative humidity should be corrected to 93 deg ET or a 2 deg change. These critical studies of the accuracy of the slope of the effective temperature lines in different regions of the chart have served to demonstrate the essential accuracy of the chart as now used.

Following the original presentation of the effective temperature chart to the Society by its Research Laboratory, it is natural that there should have been a slow acceptance of its usefulness. Its gradual but increasing rate of acceptance throughout the past eighteen years may be taken as a measure of the increasing recognition of the need for control of the atmospheric environment for human comfort and well-being. Following the original publication of the basic chart in 1923 it received attention from, and its accuracy was commented upon by those responsible for maintaining working environments in hot spaces on Naval vessels. This was demonstrated by a recent discovery in the files of the Air Conditioning Section of the Bureau of Ships, U. S. Navy, of the original paper published in 1923, together with comments indicating its essential accuracy when applied to high temperature.

The Comfort Zone. Prior to the development and acceptance of the Society's comfort chart, a *comfort zone* was defined as that range of temperatures over which most people were comfortable. This applied essentially to comfort in winter heated space. It is, therefore, natural that the establishment of the effective temperature index should have been immediately followed by a study to determine the effective temperature range under which most people are ideally comfortable. The comfort zone and the comfort line were established (9 and 15) for winter heating by the Society's Laboratory in 1923. The maximum percentage of persons was found to be comfortable at about 66 deg ET, with a decreased percentage of comfort for higher and lower effective temperatures.

With the growing application of summer cooling and air conditioning in the late twenties and early thirties, some confusion and controversy developed concerning the conditions to be maintained. The early attempts were to use the same standards for summer comfort as were used for winter comfort. This was obviously doomed to failure and the whole effective temperature idea seems to have been temporarily discarded by many in the application of summer cooling. Two reasons may be cited as accounting for this misunderstanding: first, summer cooling requires a higher effective temperature for comfort because of the effect of acclimatization; second, a person entering a cool space from the hot outside, in attempting to be in equilibrium with the hot outside, experiences a shock because he is wet with perspiration and therefore he is not in equilibrium with the environmental air of the cooled space. The lack of understanding and knowledge of these points resulted in various practices, including the maintaining of a 57 F dew point, and various dry-bulb temperatures, based upon the weather dry-bulb temperature. By 1934 this confusion had resulted in a request that the laboratory take up a study of the requirements for summer cooling. In all, eleven papers (38, 40, 44 to 48, 53, 54, 57, and 60) were presented to the Society, dealing with the optimum effective temperature for summer cooling and air conditioning and resulting from both laboratory and field studies.

These papers made some evaluation of the effect of the cold shock experienced by a person upon entering a cooled and air conditioned space from the hot outside. They also served to show that the effective temperature lines applied for

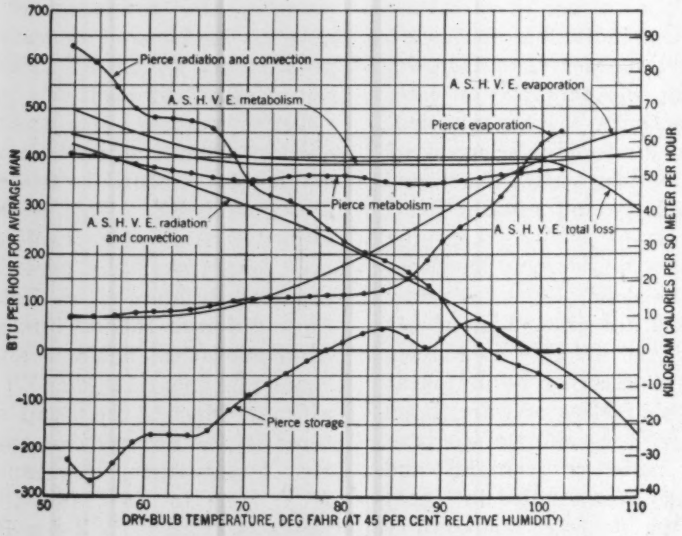

Fig. 3

mmer cooling, and that persons re comfortable in summer cooled pace at effective temperatures nging from 69 or 70 deg ET up about 72 or 73 deg ET. Studies a number of geographical locaons indicate that while there is me variation in the optimum for ifferent geographical regions in he United States, this variation is ot great. There is some variation the optimum effective temperare, depending on acclimatization nd the age and sex of the person, s indicated by the different udies, including a survey (63) of he different studies by the Techical Advisory Committee under he chairmanship of Thomas Chesr. However, the maximum variaon in the optimum is not great. ig. 4 gives optimum curves for a umber of groups and geographical egions.

Acclimatization. In all of the udies dealing with man's physiogical and psychological responses o his atmospheric environment, cclimatization has been found to e an important factor. Thus, aclimatization is shown to account or the difference in the indoor air onditioning requirement between inter and summer of from about 6 to 71 deg ET. One reason for ifficulty in establishing the winter nd summer comfort lines with preision is the fact that the time pent in the conditioned spaces tself tends to acclimatize an occuant. Obviously, if a person should pend all of his time in atmosheric environments conditioned to uit his comfort in either winter or ummer, his desire would slowly ravitate to a single optimum conition. Findings in the laboratory 59) indicate that this would probbly be between 68 and 70 deg ET or most persons. According to the est information available from the Society's Laboratory and other udies, acclimatization requires rom one to two weeks. A longer eriod is indicated for acclimatizaion to cold than is required for cclimatization to heat. The laboraory has found from seven to ten ays required for acclimatization o heat, either as a result of change n summer weather or for men working in a hot environment.

Heat Dissipation to the Atmosphere. In the application of summer cooling and air conditioning during the middle twenties, need developed for accurate data on the rate of heat dissipation from the human body to the atmosphere, and the differentiation of this heat into sensible and latent heat for different atmospheric conditions. These data were made available in a series of articles (20, 24, 67 and 68) presented to the Society and published in its Journal and in other journals. As viewed from the physiological point of view, this represents the greatest contribution of the Society's Research Laboratory and is accepted and used extensively by physiologists, particularly in studies dealing with the adaptation of man to different climatic and environmental conditions. These data are used universally by the air conditioning engineer in estimating the design cooling load resulting from occupancy.

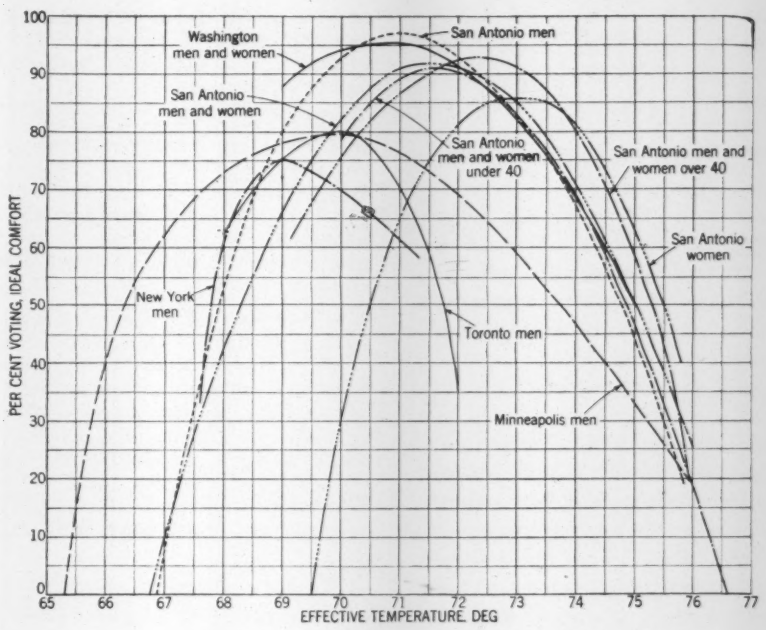

Fig. 4

Air Conditioning in Industry. The early development of comfort air conditioning found its greatest interest in attempting to provide ideal comfort in otherwise hot environments. First, the theater, and later, other audience halls, shops, restaurants, and other places of assemblage were cooled and conditioned. Usually the chief incentive was the box office receipts or appeal to prospective customers. The early and middle thirties witnessed a growing interest in the application of air conditioning to alleviate unbearable conditions in industry. The efficiency of the worker and labor laws were the major incentives.

Because of the unusual industrial surroundings, as contrasted with audience halls and other places of assemblage, and because ideal comfort is costly, it seemed necessary to base the standards to be maintained on the physiological responses of the worker and to permit conditions too warm for ideal comfort. A series of studies were initiated in 1937 which have continued until the present. The purpose in these studies was to maintain in the laboratory such environmental conditions as pertain to any given industry, to subject individuals to those conditions whilst performing rates of work which pertain to the industry and to determine their physiological reactions and responses. The worker's body temperature, pulse rate, metabolism, respiration, blood pressure, vital capacities, degree of perspiration and feeling of warmth were studied. The results of a comprehensive study (49, 56, 62, 66, 69) establish the basis for other studies applying to different industries. As was to be expected, it was found that the effective temperature of the environment was the controlling factor, and that at least a fairly wide range in relative humidity is permissible as far as the worker's comfort is concerned.

Present Conditions of Standards

and Requirements. Our knowledge concerning the physiological responses of persons to atmospheric conditions, as required for the application of air conditioning for human comfort, has kept pace with the professional and industrial requirements of the engineer. These findings have proven of great interest to the physiologist, who has only recently recognized it as a field in which he should be interested. The requirements and, therefore, the findings of the Society's Laboratory have not always involved the precision desirable for the establishment of academic scientific facts in which the physiologist is interested. Hence, there is a current interest in studies aimed to establish finer differentials between physiological response to small environmental changes. These studies will be of interest to the air conditioning engineer, and in some cases his practices may be altered in some small degree as a result thereof.

The present needs for further research as viewed from the point of view of the air conditioning engineer, include:

1. A better understanding of the relation between the comfort and health of a person, and the relative humidity of his environment, independent of the effective temperature. The results of studies at the Pierce Laboratory indicate (70) that the optimum relative humidity may be in the neighborhood of 70 per cent.

2. More accurate studies of environmental conditions, immediately above and below the sensible perspiration line, with a view of establishing the abruptness of this change and, therefore, indirectly the change in the slope of the effective temperature lines in this region of the Psychrometric Chart. Studies by the Society's laboratory would seem to indicate that any differences from present standards will be of academic rather than practical importance.

3. Further studies of the shock experienced upon entering or leaving a summer cooled and air conditioned space, from or to the hot outside weather. This is probably of greater importance to older people than those who served as subjects in the Society's studies.

4. Studies of physiological responses to heat, with a view of determining more accurately any harmful effects of exposure to moderately hot atmospheres, particularly the effect of exposure to heat during short periods of work or during the entire twenty-four hour day. Will sleeping in a comfortable environment compensate for an eight hour shift in hot industry?

Military Interest in Man's Response to His Atmospheric Environment. The violent tempo of the global war, requiring the highest degree of intelligence and performance on the part of man in handling mechanized equipment, has developed an interest in this subject far beyond anything heretofore experienced. Needless to say, the findings of the Society's Laboratory during the past twenty years have served a need in supplying a great deal of the basic data, as well as a vantage point from which the more specialized studies may proceed. However, the environmental conditions met with are much more extreme, and in many cases the need for precise data is more acute.

The demands made by the military establishments of our government upon the Society's Laboratory during the approach of the present war and the large number of members of the Society who are expert in this subject and who have been called to serve in solving these problems testify to the community of interest between the military in fighting this war and the environmental-physiological research carried on by the Society during the past 20 years. For obvious reasons, the many lines of specialized interest in these studies and the courses which they are taking cannot be discussed here. However, it may be said that many phases of the environmental-physiological subjects in which the Society and its research has been interested are being intensively investigated. Because of the urgent need for the results, these studies are seldom carried beyond the point of supplying the minimum information needed at the moment. With cessation of hostilities these findings will be available for civilian use, and it is certain that they will give a great impetus to the present day knowledge of the air conditioning engineer. Because of the spotty, as contrasted with comprehensive, nature of the studies, much will be required in correlating the results and filling in the gaps. As far as results of value to the air conditioning engineer are concerned, this will fall upon this Society and its Committee on Research. The many interests developed in this subject during the war by noted scientists, including the physiologist, aerologist, anthropologist, geographer, psychologist, and others, promise an intensified interest in the civilian application of air conditioning for human comfort after the war.

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SUMMARY OF LOCAL CHAPTER MEETINGS

Chapter	Meeting Date	Subject	Speakers	Other Features	Attendance	Attendance Ratio*
Connecticut	Jan. 4	Radiant Heating	N. W. Hosler, A. M. Byers Co.	L. E. Seeley was elected Chairman of Nominating Committee Vice-Pres. Teasdale introduced S. K. Smith, Westfield, Mass., and R. L. Blanding, Philadelphia	61	2.02
Delta	Jan. 14	Marine Piping Systems and Their Design	O. W. Page, Chief of Engrg. Plan Approval Section, Maritime Commission	Joint session with Louisiana Engrg. Society	60	0.52
Illinois	Jan. 10	Electronics Electronics at Work (sound film)	M. Brasseur, Engr., Westinghouse Elec. and Mfg. Co.	Discussion on Electronics by Messrs. Heckel, Sutcliffe, Coulter, Raymond, King, Marschall, Brooke and Gallagher	92	0.63
Iowa	Jan. 11	Wartime Activities of the FBI	J. L. Dalton, Head, Des Moines Office, FBI	F. E. Triggs reported on membership	15	0.63
Kansas City	Jan. 24	Results and Experiences in a Radiant Heated Home Pumps	A. L. Ottum, Htg. and Vtg. Engr., Glenn L. Martin-Nebraska Co. R. D. Thomas	R. B. Mason submitted Financial Report, and C.A.L. Davis reported for the Membership Committee	40	0.71
Massachusetts	Jan. 18	Calculating the Requirements for Radiant Heating	T. N. Adlam, Bethlehem, Pa.		42	0.66
Michigan	Jan. 17	Recent Developments in Heat Insulation	E. T. Cope	Messrs. Winans and Dubry put on a Double or Nothing Quiz Program War movie shown	113	1.2
Minnesota	Jan. 10	Potentialities of Post-War Business Informal Talk on Opinions as to Duration of War	Arnold Raugland, Pres., Minnesota Chapter A.I.A. H. E. Gerrish	Comments by R. W. Otto on type of construction work at present time A. B. Algren warned on results of Kilgore Bill	35	0.52
Montreal	Jan. 17	Problems and Treatment of Boiler Feed Water on 75 hp	G. R. Benskin	Retiring Pres. Hamlet introduced new Pres. A. M. Peart J. B. Dykes, Treasurer, presented his financial report	31	0.40
Nebraska	Jan. 11	Temperature Control Applications	Walter J. Baak, Omaha	John Engskow gave talk on Emergency Construction Work in Far North	23	0.52

Chapter	Meeting Date	Subject	Speakers	Other Features	Attendance	Attendance Ratio*
ew York	Jan. 17	National Anniversary Meeting Honoring Five Living Past Presidents who were also members of New York Chapter during their terms of office	D. D. Kimball, Pres. 1915 Homer Addams, Pres. 1924 W. H. Driscoll, Pres. 1926 Dr. W. H. Carrier, Pres. 1931 W. L. Fleisher, Pres. 1941	Presented each speaker with a copy of Society's Transactions of his respective term of office, with name embossed in gold lettering	117	0.63
orth Carolina	Jan. 10	Vice-Pres. Karl Selden arranged for Chapter to attend annual dinner of Charlotte Engineers Club	Dr. Zay Jeffries, Technical Dir., General Electric Lamp Dept., Nela Park, Ohio	Due to weather conditions (icy roads) attendance was limited	10	0.27
orth Texas	Jan. 17	Modern Apartment House Heating System (Illustrated)	D. C. Pfeiffer, assisted by Logan Knapp	Pres. McClanahan announced members of Program Committee	29	0.54
orthern Ohio	Jan. 10	Transitional Aspects of Building	Richard N. Jones, Western Mgr., Architectural Forum	Sound film on War Department Report released by U. S. Army.	48	0.74
klahoma	Jan. 26	Radiant Heating	C. A. Hawk, Dir. of Heating Research, A. M. Byers Co., Pittsburgh, Pa.		49	4.40
ntario	Jan. 10	Air Conditioning of Multi-room Buildings	Dr. W. H. Carrier, Syracuse, N. Y.	Joint meeting with ASME Ontario Chapter	169	0.58
regon	Jan. 6	Topic to be brought up at Society's 50th Annual Meeting	E. C. Willey, T. E. Taylor, J. J. Byrne, B. W. Farnes	Colored films of boating down the McKenzie River, through courtesy of Capt. Godfrey, Army Base at Corvallis		
acific Northwest	Jan. 12	Outline of 50th Annual Meeting of Society	E. O. Eastwood, Past-President of Society.	Two sound films by courtesy of U. S. Navy	31	0.58
hiladelphia	Jan. 13	Annual Entertainment Meeting		Reading of minutes and business waived	102	0.85
ittsburgh	Jan. 10	Heat and Its Control	R. M. Langley	Sound movie depicting attempts of man to control and make use of heat energy	29	0.44
t. Louis	Jan. 11	The Pentagon Building (illustrated with lantern slides)	C. S. Leopold, Consulting Engr., Philadelphia, Pa.	Treasurer submitted report	69	0.48

Chapter	Meeting Date	Subject	Speakers	Other Features	Attendance	Attendance Ratio*
Southern California	Jan. 19	Electronics for Post War	B. T. Barnitz, Industrial Engr., Los Angeles	Joint Meeting with ASRE Chapter	68	0.87
	Dec. 8	Sewer System of City of Los Angeles	Messrs. R. F. Brown and G. A. Parks, Sanitation Engrs.	Art Theobold gave the Treasurer's Report.	36	0.48
Washington	Jan. 12	Human Engineering	Julian Pennington, Baltimore, Md.	E. J. Febrey reported progress on lost Chapter records	47	0.32
		Outline of Program of 50th Annual Meeting of Society	R. A. Wasson, Pres. of N. Y. Chapter	F. B. Sale, Treas. submitted his report		
Western Michigan	Jan. 10	The Thermodynamics of Vegetable Dehydration	Richard Vidale, Engr., Douglas McBean Co., Rochester, N. Y.	It was unanimous that Society be given invitation to hold Summer meeting in Grand Rapids	38	0.79
	Dec. 13	Industrial Exhaust Ventilation	W. N. Witheridge, Chief, Bur. of Ind. Hygiene, Detroit		44	0.91
		Heating and Ventilating in China	Harry Sze, Chinese Engr. (sent by Chinese Govt. to U. S. to study power plant operation)		27	0.45
Western New York	Jan. 17	Comfortization of Airplane	A. J. Foote, Curtiss Wright Airplane Corp.	Pres. S. M. Quackenbush reported on membership and discussed future meeting plans	35	0.58
	Dec. 20	Annual Christmas Party		Joseph Davis and Messrs. S. W. Strouse and D. J. Mahoney provided entertainment	83	0.99
	Nov. 8	Aviation Then and Now	Lieut.-Col. (retired) Goldsborough, Army Liaison Officer	F. A. Moesel reported on membership for year	35	0.61
	Oct. 11	Forecast of Future Events	R. E. Carlin, Nash-Kelvinator Sales Corp.	Pres. Quackenbush announced appointment of several committees	41	0.66
Wisconsin	Jan. 17	Bombers over North Africa	Sound film	H. W. Schreiber spoke on progress of Bur. of Mines fuel conservation program	75	1.25
		War Department Report	Sound film			
		Annual Meeting in New York	Ernest Szekely, Chapter Delegate	Geo. Playfair, Past Pres. of Toronto Chapter, was introduced		

*The attendance ratios shown represent the meeting attendance divided by the Chapter membership. These will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by other local chapters and may be helpful in deciding on subjects for other chapter meetings.

WAR DEPARTMENT HONORS THORNTON LEWIS

For the past two years, Thornton Lewis, Past-President of the ASHVE, has been in Washington, D. C., with the Ordnance Department as Deputy Chief of the Production Branch.

On December 31 he received citation number one for distinguished service, the first of its kind to be awarded. The citation reads as follows:

THE ORDNANCE DEPARTMENT OF THE UNITED STATES ARMY
MAKES IT KNOWN
THORNTON LEWIS
has rendered distinguished service to his country in the struggle to maintain the freedom of all people. By the exercise of his initiative and ingenuity he has made a marked contribution to the War Production Program.
(Signed) L. H. CAMPBELL, JR.,
Major General, Chief of Ordnance.

Since December 15, Mr. Lewis has been chief of the Public Service Branch, Readjustment Division, Headquarters Army Service Forces. This division plans policies and procedures for the termination of contracts and the disposal of surplus property of the War Department.

EDWARDS RECEIVES CHEMICAL AWARD

Junius D. Edwards, Pittsburgh, member of the ASHVE Technical Advisory Committee on Insulation, and Assistant Director of Research of the Aluminum Company of America, received the Award of the Pittsburgh Section of the American Chemical Society at a dinner, February 17th, at the University Club, Pittsburgh. Mr. Edwards' Award is in the form of an aluminum plaque which has been presented to those who have made prominent contributions to science in the Pittsburgh district.

The presentation of the Award practically coincides with Mr. Edwards' 25th Anniversary in the aluminum industry, and the citation he received was in recognition of his distinguished service to chemistry, through his fundamental contributions in the fields of gas chemistry, the chemical and physical metallurgy of aluminum and aluminum paint, and the practical application of these developments for the betterment of mankind through his activities as inventor, author and editor.

Mr. Edwards is a native of Minneapolis, a graduate of the University of Minnesota in 1912, and is the author of a great many scientific papers and the inventor of numerous processes for the improvement of aluminum production.

He holds membership in the American Chemical Society, American Institute of Chemical Engineers, Illuminating Engineering Society, American Society of Heating and Ventilating Engineers, and a number of local organizations.

LYNCH HEADS ROME CHAMBER OF COMMERCE

William L. Lynch, president of the Rome-Turney Radiator Co., Rome, N. Y., was recently elected president of the Chamber of Commerce of that city.

Mr. Lynch has served the city in many capacities since his graduation from the Rome Free Academy. In 1940 he served as president of the Kiwanis Club. In 1941 he became trustee of the Rome Savings Bank, and has been active in the Elks and Knights of Columbus. In 1942 he was appointed by WPB as a member of the Advisory Committee of the Fin Coil and Cooler Industry.

Mr. Lynch has been president of the Rome-Turney Radiator Co. since 1921, and also holds membership in the American Society of Refrigerating Engineers.

WAID GOES TO CHICAGO

Announcement has recently been made by Scott Valve Manufacturing Co., Detroit, Mich., that Glen H. Waid, factory representative for the past 30 years, has transferred to the company's Chicago office, 15 S. Clinton St.

RUMMEL ORGANIZES SALES COMPANY

On January 15, A. J. Rummel became associated with Langhammer-Rummel Co., 436 Main Ave., San Antonio, Texas, to represent the manufacturers of various lines of heating, ventilating and mechanical equipment.

Mr. Rummel was formerly Assistant Manager of the Commercial Department of the City Public Service Board, and served as President of the South Texas Chapter, ASHVE.

DEATH OF THEODORE H. L. BACKUS

Word has just been received that Theodore H. L. Backus, who has held membership in the Society since 1916, died December 12, 1943.

Mr. Backus was born in LaPorte, Ind., June 13, 1876, and served an apprenticeship with Kenney & Quinlan, Ann Arbor, Mich., a firm that specialized in heating, ventilating and plumbing work.

He entered the partnership of Schumacher & Backus in 1904, and devoted a lifetime to the design and installation of heating, ventilating, power piping and water supply systems. He was responsible for the design and installation of many plants in the state of Michigan.

It was with sincere regret that the Officers and Council learned of his passing, and express their sincere sorrow to the family who survive.

DEATH OF M. C. GILLETT

M. C. Gillett, who has been a member of the Society since 1916, passed away January 26 after a long illness. He was born July 24, 1882, at Thompson, Pa., and after his early schooling spent 28 years with the Spencer Heater Co. as apprentice, machinist, foundry man, draftsman, salesman, branch office manager and general manager.

M. C. Gillett

In 1928 Mr. Gillett became identified with the Hoffman Specialty Co., serving successively as District Sales Manager and Assistant Sales Manager.

For several years Mr. Gillett had been seriously ill and had been on leave of absence since May 1, 1943.

He was always active in Society affairs as a member of the Philadelphia and Indiana Chapters.

Surviving are two sons, two daughters and his wife, Mrs. Florence K. Gillett, to whom the officers and Council offer their sincerest sympathy for their great loss.

DEATH OF W. MUMFORD BAILEY

The death of W. Mumford Bailey on December 21, 1943, has just been reported by his associates in London.

Mr. Bailey was born in Bristol, England, on May 27, 1885, received his preparatory education at St. George's Technical School and his college education at Merchants Venturers College, Bristol, England.

Mr. Bailey was the Managing Director of the firm of Mumford Bailey & Preston, Ltd., heating and ventilating engineers, and also was head of the British Trane Co., Ltd.

He was rated a man of outstanding ability and was the engineer for the Royal Architect, and was responsible for the design and installation of heating and ventilating systems in such important buildings as the Port of London Authority, New Lloyd's Bank Building, New Royal Mail Building, Government Hospital for World War Veterans and numerous others.

He became a member of the Society in 1930 and he was also a member of the British Institution of Heating and Ventilating Engineers and the Royal Sanitary Institute.

The Officers and Council regret the loss of a valued member, and have extended their sincerest sympathy to Mr. Bailey's family and associates.

Candidates for Membership

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the Journal of the Society or sent to the members in other approved manner as ordered by the Council. When replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 57 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by March 15, 1944, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

CANDIDATES	REFERENCES	
	Proposers	*Seconders*
ADAMS, ARCHIE K., Mgr., Montana Iron Works, Butte, Mont.	T. J. Sullivan J. C. Kelly	J. E. McDonnell B. P. Adams
ARNOLD, ROBERT S., Owner, Robert Arnold Sales & Engineering Co., Philadelphia, Pa. *(Advancement)*	M. E. Barnard M. F. Blankin	R. H. Smiles W. A. Bornemann
BAIRD, A. D. G., Pres., A. G. Baird, Ltd., Toronto, Ont., Canada.	W. H. Evans V. J. Jenkinson	W. C. Kelly A. J. Strain
BARNETT, ROBERT E., Engr. in Charge of Ventilation, L. D. Smith Shipbuilding Co., Sturgeon Bay, Wis.	E. W. Gifford M. V. Eicholtz	*R. A. Hearn *W. W. Haertel
BEST, E. THOMPSON, Mgr. Air Cond. and Refrig., Frank A. McBride Co., Paterson, N. J.	Joe Wheeler, Jr. H. J. Ryan	A. C. Buensod W. L. Fleisher
BLACKWELL, J. S., Prop., Air Engineering, Indianapolis, Ind.	S. E. Fenstermaker C. H. Hagedon	W. C. Bevington C. W. Stewart
BRADFIELD, JOSEPH L., Works Mgr., Best Universal Lock Co., Inc., Indianapolis, Ind.	C. H. Hagedon W. C. Bevington	S. E. Fenstermaker C. W. Stewart
BRAGG, ROBERT E., Mfrs. Repr., Indianapolis, Ind.	W. W. Grear C. N. Warren	C. H. Hagedon W. C. Bevington
CARTIER, MARCEL E., Research Engr., American Radiator & Standard Sanitary Corp., Yonkers, N. Y.	Bernhard Goerg Herwart Werker	C. H. Flink O. O. Oaks
CHAMBERS, S. A., Vice-Pres., Almirall & Co., Inc., New York, N. Y.	C. R. Hiers R. A. Wasson	W. J. Olvany Joe Wheeler, Jr.
CONNELL, E. C., Htg. Engr., Sullivan Valve & Engineering Co., Butte, Mont.	T. J. Sullivan J. C. Kelly	J. E. McDonnell B. P. Adams
COOPER, C. H., Htg. Asst., Chase Co., Eugene, Ore.	P. S. Chase T. E. Taylor	H. K. Mead G. H. Risley
COX, LE ROY E., Construction (Htg., Vtg. and Air Cond.) Almirall & Co., Inc., New York, N. Y.	C. R. Hiers W. J. Olvany	Joe Wheeler, Jr. C. S. Koehler
CUMMINGS, GEORGE C., N. Y. Repr. for Htg. Dept., Dravo Corp., Pittsburgh, Pa.	T. W. Reynolds B. B. Reilly	D. E. McCulley E. J. Ritchie
DARLING, ROBERT B., Pres., Robert B. Darling Co., Inc., New York, N. Y.	C. R. Hiers H. J. Ryan	C. S. Pabst F. D. Lawrence
DONCEEL, G. T., Industrial Engr., Oklahoma Natural Gas Co., Oklahoma City, Okla.	E. T. P. Ellingson E. W. Gray	F. X. Loeffler W. A. Russell
DUNN, ROBERT, Chief Engr., The Canadian Bank of Commerce, Toronto, Ont., Canada.	D. A. Stott E. S. Spall	Arthur Nearingburg A. J. Strain
GAMBLE, BURTON L., Designing Engr., Industrial Htg. Equipment, McCann Furnace Co., Cleveland, Ohio.	R. W. Sheldon R. A. Wilson	R. H. Sweeney W. R. Moore
GIBBONS, MICHAEL J., Jr., Htg. Engr., M. J. Gibbons Supply Co., Dayton, Ohio.	M. J. Gibbons W. C. Green	N. J. Smith H. E. Sproull
HARDER, E. PAUL, Htg.-Vtg. Engr., Emerson Electric Manufacturing Co., St. Louis, Mo.	H. C. Sharp E. E. Carlson	G. C. Schwarz H. R. Halt
HARRINGTON, JEREMIAH P., Mech. Engr., U. S. Engineers, Omaha, Nebr.	D. E. McCulley B. G. Peterson	D. D. Williams E. F. Adams
HOSTETTER, J. C., Pres., Mississippi Glass Co., St. Louis, Mo.	E. H. Hobbie G. B. Watkins	J. E. Frazier R. A. Miller
HUBBELL, NED S., Plbg. & Htg. Engr., Mueller Brass Co., Port Huron, Mich.	*S. Saulson *F. K. Boomhower	*G. S. Whittaker H. E. Ziel
JANSSEN, HENRY J., Treas., Child & Scott-Donohue, Inc., New York, N. Y.	G. M. Scott C. S. Koehler	E. A. Bennett C. L. Chase
LANGE, CLIFFORD C., Htg. Engr., Supvr., Installation, Sullivan Valve & Engineering Co., Butte, Mont.	T. J. Sullivan J. C. Kelly	J. E. McDonnell B. P. Adams
LUBKING, CHARLES J., Engr., Sales, Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.	J. E. Hutchison E. H. Dafter	A. C. Caldwell H. B. Prewitt
LUZZI, THEODORE E., Engr., Almirall & Co., Inc., New York, N. Y.	C. R. Hiers R. A. Wasson	J. A. Heller W. J. Olvany

MARGARELL, KENNETH R., Mgr., Htg. Dept., Baker Manufacturing Co., Omaha, Nebr.

MASON, ROBERT E., Owner, Robert E. Mason & Co., Charlotte, N. C.

MAXWELL, THOMAS N., Mgr., Northwest Supply Co., Butte, Mont.

MEATES, RICHARD F., Sgt., U. S. Army, Overseas.

MCMAHON, LOUIS A., Htg. Engr., American Furnace Co., St. Louis, Mo.

MOLONY, JAMES J., Steam Engr., Nebraska Defense Corp., Mead, Nebr.

MONTESANO, FRANK P., Mgr., The Frank A. McBride Co., Paterson, N. J.

MUELLER, ERVIN J., Sales Engr., Sullivan Valve & Engineering Co., Butte, Mont.

MURRAY, W. W., JR., Vice-Pres., Almirall Co., Inc., New York, N. Y.

NATKIN, A. J., Partner-Houston Office Mgr., Natkin & Co., Houston, Texas.

OBERSCHULTE, R. H., Sales & Field Engr., D. T. Randall & Co., Detroit, Mich. *(Advancement)*

OLDS, DEAN, Chief Engr., Coleman Lamp & Stove Co., Wichita, Kans.

PIEKSEN, GEORGE W., Sales Repr., St. Louis, Mo.

PURINTON, DEXTER J., Asst. Plant Mgr., Wright Aeronautical Corp., Paterson, N. J. *(Advancement)*

REED, THOMAS M., Jr., Sales Engr., John J. Nesbitt, Inc., New York, N. Y.

RITTER, IRVING S., Design Engr., Westinghouse Electric Elevator Co., Jersey City, N. J.

SCHULMEISER, W. A., Sales Mgr., American District Steam Co., N. Tonawanda, N. Y.

SMART, J. HOWARD, Vice-Pres. in Charge of Sales, Tuttle & Bailey, Inc., New Britain, Conn.

SMITH, W. E., SR., Draughtsman, Kodak, Ltd., Wealdstone, Middlesex, England.

SMYTH, GEORGE E., Service Mgr., Consolidated Conditioning Corp., Mt. Vernon, N. Y.

STEEL, WILLIAM H., Jr., Owner, Arnold R. Kamman Co., Buffalo, N. Y.

STEVENS, JOSEPH W., Dist. Mgr., Minneapolis-Honeywell Regulator Co., Syracuse, N. Y.

STOVER, R. S., Managing Partner, Engineering Equipment Co., Marshalltown, Ia.

SWART, HARVEY G., Salesman & Engr., The Trane Co., Chicago, Ill.

TALLEY, DEAN, Quarterman Pipefitter, United States Naval Training Station, Farragut, Idaho.

TROWBRIDGE, C. Y., Secy.-Treas. and Gen. Mgr., Ray F. Fischer Co., Oklahoma City, Okla.

UICKER, JOHN J., Prof. and Acting Dir., Mech. Engrg. Dept., University of Detroit, Detroit, Mich.

ULLRICH, A. B., Jr., Sales Engr., Gilbert Engineering Co., Dallas, Texas. *(Reinstatement and Advancement)*

VERITY, ELBERT W., Pres., Almirall & Co., Inc., New York, N. Y.

ZAVORSKI, LEONARD, Vice-Pres. in Charge of Prod., Tuttle & Bailey, Inc., New Britain, Conn.

B. G. Peterson	Verne Simmonds
Henry Kleinkauf	D. E. McCulley
K. W. Selden, Jr.	W. M. Wallace
S. H. Downs	C. R. McConner
T. J. Sullivan	J. E. McDonnell
J. C. Kelly	B. P. Adams
*R. E. Macy	E. K. Campbell
*J. H. Santz	M. F. Blankin
B. C. Simons	L. R. Szombathy
H. E. Grossenbacher	G. B. Rodenheiser
Verne Simmonds	G. E. Merwin
B. G. Peterson	D. E. McCulley
Joe Wheeler, Jr.	A. C. Buensod
H. J. Ryan	W. L. Fleisher
T. J. Sullivan	J. E. McDonnell
J. C. Kelly	B. P. Adams
C. R. Hiers	W. J. Olvany
Joe Wheeler, Jr.	J. A. Heller
F. C. Brandt	H. L. Jones
A. F. Barnes	A. B. Banowsky
E. F. Hyde	H. E. Ziel
G. H. Tuttle	T. H. Mabley
M. M. Rivard	W. A. Russell
C. A. Davis	O. A. Forslund
H. C. Sharp	G. W. F. Myers
E. E. Carlson	L. W. Moon
A. V. Hutchinson	Russell Tree
W. E. Heibel	Philip Greise
R. A. Wasson	H. H. Bond
C. S. Koehler	Joe Wheeler, Jr.
A. H. Goelz	H. E. Gould
L. G. Huggins	Henry Kleinkauf
C. W. Stewart	M. F. Blankin
G. D. Winans	M. N. Musgrave
Stanley Hart	A. F. Hinrichsen
T. S. Hart	G. W. F. Myers
E. A. Pearce	*F. C. Burton
*C. F. Kingham	*A. C. Ellis
Thomas Baker	J. D. W. Robertson
H. J. Rose	C. S. Koehler
S. W. Strouse	F. J. Weber
Herman Seelbach, Jr.	D. J. Mahoney
H. F. Randolph	A. L. Hesselschwerdt, Jr.
A. B. Newton	C. F. Woese
C. W. Helstrom	B. E. Landes
D. E. Wells	W. W. Stuart
J. S. Kearney	R. O. Nelson
W. C. Zingheim	H. T. Kucera
T. J. Sullivan	J. E. McDonnell
J. C. Kelly	B. P. Adams
E. T. P. Ellingson	E. W. Gray
F. X. Loeffler, Sr.	W. A. Russell
F. J. Linsenmeyer	*H. E. Mayrose
*O. F. French	*Jasper Gerardi
T. H. Anspacher	L. S. Gilbert
W. H. Moler	L. C. McClanahan
C. R. Hiers	Joe Wheeler, Jr.
W. J. Olvany	C. S. Koehler
Stanley Hart	A. F. Hinrichsen
T. S. Hart	G. W. F. Myers

*Non-Member.

Candidates Elected

In the past issues of the Journal of the Society the names of the following men were listed as Candidates for Membership. The membership grade of each Candidate has been assigned by the Committee on Admission and Advancement and balloted upon by the Council. We are now instructed by the Council to post herewith, as required by Art. B-III, Sec. 8, of the By-Laws, the following list of candidates elected:

MEMBERS

CONOVER, E. W., Research Engr., Detroit Steel Products Co., Detroit, Mich. *(Reinstatement)*

DOLAN, H. P., Dir., Engrg. and Bldg. Operation, Board of Education, Detroit, Mich. *(Reinstatement)*

EELLS, HENRY B., New York Mgr., Barnes & Jones, Inc., New York, N. Y. *(Reinstatement)*

HILL, FRED M., Engr., 225 East Avenue 39, Los Angeles, Calif. *(Reinstatement)*

PERHAM, STANLEY H., Cons. Engr., 455 Architects & Builders Bldg., Indianapolis, Ind. *(Reinstatement)*

ROTZ, J. M., Owner, J. M. Rotz Engineering Co., Indianapolis, Ind. *(Reinstatement)*

ASSOCIATES

KING, HARRY K., Field Service Engr., A. M. Byers Co., Philadelphia, Pa. *(Reinstatement)*

SKIDMORE, JOHN G., Sales Engr., Almirall & Co., Inc., New York, N. Y. *(Reinstatement)*